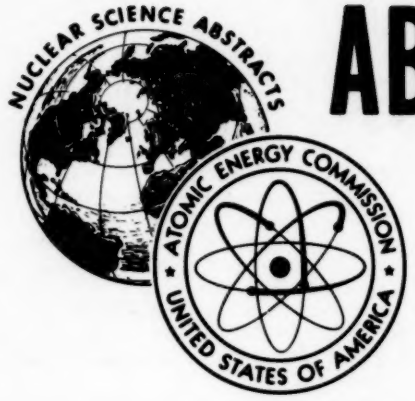
NUCLEAR SCIENCE ABSTRACTS



Volume 30 Number 8

Abstracts 20579-23495

October 31, 1974

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Volume 30, Number 8, October 31, 1974

NUCLEAR SCIENCE ABSTRACTS

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Nuclear Science Abstracts provides the only comprehensive abstracting and indexing coverage of the international nuclear science literature. It covers scientific and technical reports of the U. S. Atomic Energy Commission and its contractors, other U. S. Government agencies, other governments, universities, and industrial and research organizations. In addition, books, conference proceedings, individual conference papers, patents, and journal literature on a worldwide basis are abstracted and indexed. Each issue of *Nuclear Science Abstracts* includes four indexes: subject, personal author, corporate author, and report number.

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Personal Authors

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

SMITH, H., Planetary nebulae: two types, 29:13374
SMITH, H.R. Jr., Principles of electron beam technology, 29:13155
SMITH, J., See HOEGERMAN, S.F., 29:13035
See HOEGERMAN, S.F., 29:13037

Subjects

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Problems on nuclear reactor structure at elevated temperature, 29:14654
REACTOR PROTECTION SYSTEMS
HTGR gas turbine power plant control and safety studies. Quarterly progress report for the period July 1, 1973--September 30, 1973, 29:14846 (GULF-GA-A-12799)

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14452 (WASH-1278) CTR ENGINEERING SYSTEMS STUDY REVIEW MEETING, GERMANTOWN, MARYLAND, SEPTEMBER 19 AND 20, 1973. Gough, W. C. **(USAEC Division of Controlled Thermonuclear Research, Washington, D. C.).** 1973. 258p. (CONF-730971-). Dep. NTIS $7.60.

is indexed as:

USAEC DIVISION OF CONTROLLED THERMONUCLEAR RESEARCH, WASHINGTON, D.C.
CTR engineering systems study review meeting, Germantown, Maryland, September 19 and 20, 1973, 29:14452 (WASH-1278)

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Dissertations from *Dissertation Abstracts International, Part B* that are included in *Nuclear Science Abstracts* are available from University Microfilms, Inc., 315 N. First Street, Ann Arbor, Michigan 48103.

Information on the availability of the published literature and unpublished conference papers abstracted in *Nuclear Science Abstracts* can be obtained from the USAEC Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830.

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Volume 30, Number 8 October 31, 1974

NUCLEAR SCIENCE ABSTRACTS

CHEMISTRY

Analytical and Separations Chemistry

Refer also to abstract 21841.

20579 (CONF-730802-) PROCEEDINGS OF THE FIRST ANNUAL NSF TRACE CONTAMINANTS CONFERENCE, OAK RIDGE NATIONAL LABORATORY, AUGUST 8–10, 1973. Fulkerson, W.; Shults, W. D.; Van Hook, R. I. (comps.). (Oak Ridge National Lab., Tenn. (USA)). Mar 1974. 775p. Dep. NTIS $13.60.

From 1st annual NSF trace contaminants conference; Oak Ridge, Tennessee, USA (8 Aug 1973).

Papers presented are grouped under the following topics: environmental contamination by lead, modeling transport and biological translocation, measurement of sources and environmental levels, transport and ecosystem modeling, sampling strategy and analytical measurements, ecological and biomedical effects and measurements, measuring environmental distribution and cycling, and implementing the use of results from RANN programs. Separate abstracts were prepared for 3 papers. One paper appeared previously in NSA as 29:04826. (MCG)

For abstracts of individual papers see: 20581, 20613, and 20640.

20580 DEVELOPMENT OF ANALYTICAL CHEMISTRY IN 1972 (REVIEW). Pilipenko, A. T.; Volkova, A. I. Ind. Lab. (USSR) (Engl. Transl.); 39: No. 12, 1837-1861(Dec 1973).

Translated from Zavod. Lab.; 39: No. 12, 1425-1448(Dec 1973).

Data published in 1972 on the methods used in the analysis of inorganic compounds are reviewed and presented in tabular form. Extraction methods, new organic reagents, chromatography and ion exchange, spectral and atomic-absorption methods of analysis, x-ray spectral and x-ray fluorescence analysis, neutron activation and radiometric methods of analysis, phase (material) analysis, electrochemical methods, and concentration of microimpurities are cited. 285 references. (JSR)

Activation and Nuclear Reaction Procedures

Refer also to abstracts 20693, 20695, 20696, 21154, and 22805.

20581 (CONF-730802-, pp 463-503) HUMAN HAIR AS AN INDICATOR OF TRACE METAL ENVIRONMENTAL EXPOSURE. Gordus, A. A.; Maher, C. C. III; Bird, G. C. (Univ. of Michigan, Ann Arbor). Mar 1974.

From 1st annual NSF trace contaminants conference; Oak Ridge, Tennessee, USA (8 Aug 1973).

In proceedings of the first annual NSF trace contaminants conference.

Both present-day and historical head-hair samples up to 200 years old are being analyzed for 38 trace elements using neutron activation and flameless atomic absorption spectrophotometry. This study, which will allow determining the extent of environmental trace-metal pollution, was designed to permit evaluating the relationship between the trace-metal content of hair and (a) a wide variety of factors such as age, sex, diet, hair color, shampoos, extent of hair washing, etc., (b) the trace-metal content of blood and (c) the level of human intake of trace metals from pre-industrial periods to the present. Examples of some of the initial historical and modern hair analysis data will be presented. In some cases it appears that the human intake of certain trace metals may have decreased during the last 100 years. (auth)

20582 (INIS-MF-1168-2, pp vp, 22p) APPLICATIONS OF NUCLEAR TECHNIQUES IN INDUSTRY AND ENVIRONMENTAL STUDIES. Kuusi, J. (Technical Research Center of Finland, Otaniemi). 1973.

From Finnish summer school in nuclear physics; Liperi, Finland (11 June 1973).

Examples of applications described include: activation analysis, radioisotope x-ray techniques, industrial process studies using radioisotope tracers, and surface water flow studies using radioisotope tracer techniques. (MCG)

20583 (JUL-1046-CT) NONDESTRUCTIVE CONTROL OF FISSILE MATERIAL CONTAINING RADIOACTIVE FISSION PRODUCTS WITH A Sb–Be NEUTRON SOURCE BY SELECTIVE TRANSPORT OF FISSION NEUTRONS IN HYDROGENOUS MATERIAL. Filss, P. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Chemische Technologie). Feb 1974. 33p. Dep. NTIS (US Sales Only) $4.75.

Growing use of nuclear power needs a simple method of fissile material determination. Following an approach of Fermi, an activation arrangement with a Sb-Be neutron source was chosen to interrogate fissile material by selective transport of fission neutrons. The arrangement was tested and results agree well with approximation calculations. The arrangement proves equally well suited for the determination of fissile material in unirradiated and irradiated fuel elements and other samples, e.g., wastes. The interrogating source (10 Ci Sb-124) leads typically to a count-rate of 8 cps when 1 g ^{235}U is present in the sample. Under these conditions, the background and source count-rate is less than 1%. (auth)

20584 (KFKI-74-16) EFFECT OF THE SPATIAL- AND TIME-FLUCTUATIONS OF THE IRRADIATING FLUX ON THE ACCURACY OF THE ACTIVATION ANALYSIS. Vass, Sz.; Vorsatz, B.; Keszei, B. (Kozponti Fizikai Kutato Intezet, Budapest (Hungary)). May 1974. 18p. Dep. NTIS (US Sales Only) $4.00.

The fluctuation in the number of atoms activated by irradiation is related by a simple formula to the parameters of small changes in sample position and irradiating particle flux. The results of numerical calculations with this formula in order to establish the conditions of maximum analytical accuracy for activation with accelerators are presented. (auth)

20585 POSSIBILITIES OF GAMMA-ACTIVATION DETERMINATION OF OXYGEN AND FLUORINE BY DETECTION OF DELAYED NEUTRONS. Dorosh, M. M.; Mazyukevich, N. P.; Parlag, A. M.; Shkoda-Ul'yanov, V. A. At. Energ. (USSR); 35: No. 5, 339-342(Nov 1973). (In Russian).

The bases of the method for the determination of oxygen and fluorine from the reactions $^{18}O(\gamma,p)$ and $^{19}F(\gamma,2p)$ by the registration of delayed neutrons were experimentally studied. The cross section for the reaction $^{18}O(\gamma,p)$ is 12 ± 4 mb at the maximum (at 23 ± 0.5 MeV). The delayed neutron yield from oxygen (in the energy range from 16.5 to 70 MeV) and from fluorine (in the energy range from 51 to 67 MeV) was measured. The contribution of the interfering reactions is insignificant and can be neglected. The sensitivity of the method at an energy of 50 MeV, beam current of 50 μamp, and analysis time of 30 sec was 2×10^{-3} g for oxygen and 1.5×10^{-4} g for fluorine. (tr-auth)

20586 PHOTON ACTIVATION ANALYSIS OF BIOLOGICAL MATERIALS. II. Elemental Abundances of NBS Standard Refer-

ence Material, Bovine Liver. Kato, T. (Tohoku Univ., Sendai); Sato, N. Kakuriken Kenkyu Hokoku; 6: No. 2, 308-318(Dec 1973).

Nondestructive multi-element analysis by 30-MeV bremsstrahlung photon activation with high-resolution gamma-spectrometry was applied to the determination of trace elements in the NBS biological matrix standard reference material, Bovine Liver. Simultaneous irradiation of the sample with synthetic multi-element standards containing 25 elements has shown that the method is successful with regard to the capability of determining such essential elements as calcium, chlorine, iron, magnesium, potassium, rubidium, sodium and zinc. The principal nuclides, their gamma-rays used in the determinations, and the best time after irradiation for counting are summarized. Agreement of the results with published data is excellent. (auth)

20587 ALUMINUM, TITANIUM, AND VANADIUM IN RECENT AND FOSSIL SHELLS. V. Ohta, N.; Tomura, K.; Omori, M. (Tokyo Metropolitan Univ.). Nippon Kagaku Kaishi; 1974: No. 4, 703-711(Apr 1974). (In Japanese).

To study the behaviors of trace elements in shells during the process of fossilization, aluminum, titanium and vanadium, contained in shells belonging to Pelecypoda collected from Miocene, Pliocene, Pleistocene and Recent deposits in northeastern Japan, were determined by nondestructive neutron activation analysis. The samples were irradiated in the TRIGA Mark II Reactor of Rikkyo University (thermal neutron flux: 5×10^{11} n/cm^2/sec) for 3 min. After cooling for 3 min, γ-rays of ^{28}Al, ^{51}Ti, and ^{52}V were measured for 5 min using a 4096 channel GEOSCIENCE pulse height analyzer and an ORTEC Ge(Li) detector (effective volume: 50 ml). The contents of aluminum, titanium, and vanadium in Recent shells have been found to correlate with the crystal-form of calcium carbonate and the shell structure: each content of the three elements in calcite type shells with foliated structure was higher than that in aragonite type shells and calcite type shells with homogeneous or complex prismatic structure. Although the contents of aluminum, titanium, and vanadium in fossil shells generally increased with increasing age contrary to the decrease in residual organic matters in shells, the pattern and the degree of increase changed with variation of the shell structure and the crystal-form of calcium carbonate. On the other hand, the V/Al ratio of fossil shells seemed to increase in proportion to that of the environmental sediments. These results suggested that aluminum, titanium, and vanadium in fossil shells were supplied from the surrounding sediments during the progress of fossilization. (auth)

20588 ANALYSIS OF SEVERAL TYPES OF STEELS AND ALLOYS BY IRRADIATION IN MIXED NEUTRON FLUXES USING A NEUTRON GENERATOR. Muminov, V. A.; Navalikhin, L. V.; Khamrakulov, K. (Inst. of Nuclear Physics, Tashkent). Ind. Lab. (USSR) (Engl. Transl.); 40: No. 1, 69-71(Jan 1974).

Translated from Zavod. Lab.; 40: No. 1, 53-55(Jan 1974).

A method for determining Si, Cr, Fe, and Mn in several experimental chrome-nickel-tungsten steels and alloys is described. The first three of these components are determined from the activity of the corresponding radioisotopes which are formed when the sample is irradiated in a fast neutron flux while the manganese content is determined after irradiation in a thermal neutron flux. (LK)

20589 YADERNO-FIZICHESKIE METODY ANALIZA MINERAL'NOGO SYR'YA. (Nuclear-Physical Techniques for Analyzing Mineral Products). Yakubovich, A. L.; Zaitsev, E. I.; Przhiyalgovskii, S. M. Moscow; Atomizdat (1973). 391p.

A brief review on the structure of the atom is given. The processes for the interaction of different forms of ionizing radiation with matter are discussed. The sources and detectors of radiation and the characteristics of the construction of individual elements of the analyzing apparatus are examined. The largest part of the book is concerned with a description of laboratory nuclear physical methods of analysis which are used at the present for extensive apparatus design and for widely approved practices. Questions on the complexity of analysis methods for mineral raw materials and questions on the precision and sensitivity of these analysis methods are discussed. (tr-auth)

20590 RARE EARTH ANALYSIS OF USGS ROCKS SCo-1 AND STM-1. Evaluation of Standards for Homogeneity and of the Precision and Accuracy of a Procedure for Neutron Activation Analysis. Kosiewicz, S. T.; Schomberg, P. J.; Haskin, L. A. (Univ. of Wisconsin, Madison). J. Radioanal. Chem.; 20: No. 2, 619-626(1974).

Twelve of the rare earth elements (La, Ce, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Yb, and Lu) were determined by radiochemical neutron activation analysis on two samples per bottle from two bottles each of SCo-1 (Cody shale) and STM-1 (nepheline syenite). The data provide no evidence for differences in REE concentrations between bottles of the same rock. Values of the concentrations for most of the REE in SCo-1 and STM-1, based on the samples analyzed, have been established to better than ±10% overall uncertainty, with a 95% confidence limit. (auth)

20591 NEUTRON ACTIVATION ANALYSIS OF TIN IN BIOLOGICAL MATERIALS AND THEIR ASH USING ^{123}Sn AND ^{125}Sn. Byrne, A. R. (Univ. of Ljubljana, Yugoslavia). J. Radioanal. Chem.; 20: No. 2, 627-627(1974).

Tin was determined in biological materials by NAA of the γ-emitting 40-min ^{123}Sn and 9.7-min ^{125}Sn isotopes at the sub-ppM level. For ^{123}Sn, samples are wet-ashed after irradiation, whereas to allow fast radiochemistry for ^{125}Sn, the samples are dry-ashed prior to the irradiation. Both separation techniques rely on selective solvent extraction of tin(IV) iodide, and NaI(Tl) counting. Comparative analyses of several materials by both methods gave good agreement, indicating that tin is not lost on dry-ashing and that simple dissolution of the ash in an HCl-HI mixture is complete. Results by both techniques are presented for the standard materials Bowen's Kale and NBS Orchard Leaves, and for some other materials. (auth)

20592 COMPARISON STANDARDS FOR NEUTRON ACTIVATION ANALYSIS ON A BASE OF PHENOL-FORMALDEHYDE RESIN. Kolomi'tsev, M. A.; Ambardanashvili, T. S.; Dundua, V. Yu. (Inst. of Physics, Tbilissi, USSR). J. Radioanal. Chem.; 20: No. 2, 549-557(1974).

The possibility of preparation of comparison standards for activation analysis on a base of phenol-formaldehyde polymer was shown. This polymer contains only a small amount of neutron-sensitive impurities. The suggested standards may be prepared in large amounts under laboratory conditions. (auth)

20593 RELIABILITY OF MERCURY ANALYSIS IN ENVIRONMENTAL MATERIALS. Heinonen, J.; Suschny, O. (International Atomic Energy Agency, Vienna). J. Radioanal. Chem.; 20: No. 2, 499-519(1974).

Nine intercomparisons of the determination of mercury present as impurity in different materials have been organized. 24 laboratories in 10 different countries took part, mainly using activation analysis and atomic absorption techniques. The results show that the reliability of the data produced and reported in this area leaves much to be desired, and that continuous control of the quality of mercury analysis in the extremely low concentration range is essential. (auth)

20594 SUBSTOICHIOMETRIC SEPARATION OF INDIUM BY EXTRACTION WITH 8-HYDROXYQUINOLINE AND ITS APPLICATION TO THE DETERMINATION OF INDIUM IN SEMICONDUCTOR GRADE SILICON. Zmijewska, W. (Inst. of Nuclear Research, Warsaw). J. Radioanal. Chem.; 20: No. 2, 521-527(1974).

A substoichiometric extraction method of indium with 8-hydroxyquinoline and its application to the determination of indium in semiconductor silicon are described. (auth)

20595 ACCURATE PROCEDURE FOR MULTIELEMENT NEUTRON ACTIVATION ANALYSIS OF TRACE ELEMENTS IN BIOLOGICAL MATERIALS. Henzler, T. E.; Korda, R. J.; Helmke, P. A.; Anderson, M. R.; Jimenez, M. M.; Haskin, L. A. (Univ. of Wisconsin, Madison). J. Radioanal. Chem.; 20: No. 2, 649-663 (1974).

A procedure for radiochemical neutron activation analysis of biological materials for As, Cd, Co, Cu, Ga, Hf, Hg, Mn, Na, Sb, Sc, Se, Zn, and the rare earth elements (REE) was developed. Maximum control over accuracy was emphasized. Samples are digested under reflux in the presence of carrier for every element determined, and a chemical yield is measured for every element assayed. The procedure was tested by replicate analysis of National Bureau of Standards bovine liver sample (SRM-1577). Values agree to within their uncertainties with those given by NBS for the 9 elements of this group that they have analyzed. Accuracies at the 90% confidence level for elements in the liver sample are estimated as better than ±10% for Cu, Na, and Zn, between ±10 and ±25% for As, Co, Hg, La, Mn, and Se, and between ±25 and ±50% for Cd, Sb, Sc, and Sm. (auth)

20596 RAPID DETERMINATION OF MOLAR RATIOS IN BINARY SYSTEMS BY 14 MeV NEUTRON ACTIVATION ANALYSIS. Determination of Molar Ratios of Iron(III) Oxide and Zinc Oxide in Zinc Ferrites. Chiba, M. (Natural Research Inst. for Metals, Tokyo). J. Radioanal. Chem.; 20: No. 2, 665-676(1974).

The 14-MeV neutron activation analysis method was applied for the rapid and nondestructive determination of the molar ratios of iron(III) oxide and zinc oxide in zinc ferrites. Iron was detected as ^{56}Mn produced from ^{56}Fe by the (n,p) reaction, and zinc as the

sum of the coincidence counts of the annihilation radiations of the positrons emitted from ^{63}Zn and ^{64}Cu produced from ^{64}Zn by the (n,2n) and (n,p) reactions, respectively. The ratios of the counts of ^{56}Mn and the sum of the coincidence counts were not linearly related to the molar ratios of iron(III) oxide and zinc oxide in zinc ferrites. However, by corrections of the mutual contributions to the counts, linear relations were obtained between the ratios of the counts and the molar ratios when the corrected sum of the coincidence counts was used as an internal standard. The experimental and theoretical slopes of the analytical lines agreed within a difference of approximately 10%. The deviations between the results of the activation analysis and those of the chemical analysis were less than 5% of the chemical results. (auth)

20597 ACCURATE FAST NEUTRON ACTIVATION ANALYSIS FOR OXYGEN IN GEOLOGICAL MATERIALS. Bibby, D. M.; Sellschop, J. P. F. (Univ. of the Witwatersrand, Johannesburg). J. Radioanal. Chem.; 20: No. 2, 677-693(1973).

Sources of error in the fast neutron activation analysis determination of oxygen were investigated and minimized. The oxygen contents of eighteen international rock standards and a sulfide ore standard were determined, and compared with the values calculated by difference using the reported full analyses. Accuracies of 0.3% average deviation and reproducibilities of ±0.2% standard deviation were obtained, where oxygen contents exceeded 1.0 g. (auth)

20598 INSTRUMENTAL METHOD FOR THE DETERMINATION OF TRACE ELEMENTS IN WATER SAMPLES BY NEUTRON ACTIVATION ANALYSIS. Clemente, G. F.; Mastinu, G. G. (CNEN-CSN, Rome). J. Radioanal. Chem.; 20: No. 2, 707-714 (1974).

Thermal neutron activation analysis and a large-volume high-resolution Ge(Li) gamma spectrometer, connected on-line to a DEC PDP 8/L computer, were used to measure the concentrations of Na, Sc, Cr, Fe, Co, Ni, Zn, As, Se, Br, Rb, Ag, Sb, Cs, W, and Hg in some Italian subsurface water samples. The instrumental method requires neither a chemical separation technique nor a pre- or post-concentration of the trace elements to be detected. As a consequence, this method eliminates many inherent errors associated with chemical determinations. The technique is sensitive, precise, and particularly suitable for routine analysis of many trace elements at both natural and pollution levels in water samples. The interferences due to fast neutron (n,p) and (n,α) reactions are not appreciable, with the only exception of the ^{54}Fe(n,p)^{54}Mn and ^{58}Ni(n,p)^{58}Co reactions. Losses of volatile elements, (e.g., As, Br and Hg) during irradiation proved to be negligible. (auth)

20599 SURVEY OF 43 CONSTITUENT ELEMENTS IN KIDNEY SAMPLES BY INSTRUMENTAL ACTIVATION ANALYSIS. Velandia, J. A. (Instituto Venezolano de Investigaciones Cientificas, Caracas); Perkons, A. K. J. Radioanal. Chem.; 20: No. 2, 715-727(1974).

Thermal neutron activation analysis and instrumental semiconductor gamma spectrometry were used to determine the amounts of 43 elemental constituents in the kidneys of rabbits. The results for dried kidney tissue of 12 different rabbits, in parts per million, are given for 37 elements, with qualitative determination of 6 elements more. Typical gamma-photopeak spectra at various irradiation and decay times are shown. (auth)

20600 ACTIVATION ANALYSIS OF GEOLOGICAL MATERIAL USING RUTHENIUM AS A MULTIISOTOPIC COMPARATOR. Van der Linden, R.; Corte, F. D.; Hoste, J. (Univ., Ghent). J. Radioanal. Chem.; 20: No. 2, 729-743(1974).

The isotopes ^{97}Ru, ^{103}Ru, and ^{105}Ru, produced by reactor irradiation of elemental ruthenium, were applied as triple comparators in the activation analysis of rock FU-41, a basanitoid from Fuerteventura, Canary Island. The concentrations of the following elements were determined: Sm, Sc, Fe, Co, Na, La, Hf, Eu, Th, and Cr. The aim of this work was the experimental control of the error theory of the multiple comparator method as well as the experimental check of the accuracy. (auth)

20601 ION-EXCHANGE GROUP-SEPARATION SCHEME FOR RAPID ANALYSIS OF THE COMPONENTS OF NEUTRON-ACTIVATED BIOLOGICAL TISSUES. Velandia, J. A.; Perkons, A. K. (Instituto Venezolano de Investigaciones Cientificas, Caracas). J. Radioanal. Chem.; 20: No. 2, 473-487(1974).

A simple ion-exchange separation scheme was developed for the separation of over 50 constituent chemical elements in biological tissues into 12 to 15 groups suitable for quantitative gamma spectrometry. The scheme incorporates several important improvements and modifications of earlier radiochemical ion-exchange separation procedures, and allows rapid simultaneous quantitative analyses of a large number of constituent components in tissues. The procedures can easily be adapted for use with a variety of other materials and mixtures. The components of the various fractions are listed and their gamma-spectrometric analysis is discussed. The separation is comparatively quick, and yields clean and easily identifiable components. (auth)

20602 NEUTRON ACTIVATION ANALYSIS OF SOME OF THE BIOLOGICALLY ACTIVE TRACE ELEMENTS IN FISH. Pillay, K. K. S.; Thomas, C. C. Jr.; Hyche, C. M. (State Univ. of New York, Buffalo). J. Radioanal. Chem.; 20: No. 2, 597-606 (1974).

Highly specific neutron activation analysis procedures involving post-irradiation chemical separations were developed for the determination of Cu, Hg, Zn, Cd, As, Se and Cr in fish tissues. The procedures developed were used to determine the levels of these biologically active elements in some of the commercially important fish species of Lake Erie. The nuclear analytical procedures developed generally involved the irradiation of fish tissues followed by wet-ashing in the presence of nonradioactive carriers. From the homogeneous solution of the tissue digest, the elements of interest were chemically isolated and the radioactivities were measured by scintillation gamma-ray spectrometry. The results reported include both the determination of the precision and accuracies of each of these elemental analyses and a survey of these seven elements in nine major fish species of Lake Erie. (auth)

20603 DETERMINATION OF URANIUM IN THORIUM MATRIXES BY EPITHERMAL NEUTRON ACTIVATION ANALYSIS. Atalla, L. T.; Lima, F. W. (Instituto de Energie Atomica, Sao Paulo, Brazil). J. Radioanal. Chem.; 20: No. 2, 607-618(1974).

Uranium in thorium matrixes or in minerals and ores containing thorium is determined by epithermal neutron activation analysis (ENAA). In some minerals and ores, such as monazite sands, the analysis can be carried out by purely instrumental means with no chemical separation of uranium or thorium from the irradiated matrix. For thorium compound matrixes with very low uranium contents, a rapid radiochemical separation method, based on the retention of uranyl ion on anion-exchange resins, is first carried out, before counting the gamma-ray peaks for ^{239}U in multichannel analyzers coupled to NaI(Tl) scintillators or to Ge(Li) detectors. (auth)

20604 PROMPT NUCLEAR ANALYSIS. Bird, J. R. (Australian Atomic Energy Commission Research Establishment, Lucas Heights); Price, P. B. At. Energy Rev.; 12: No. 2, 275-342(1974).

A summary is presented of analytical applications of the detection of prompt radiation from nuclear reactions. By choice of type and energy of incident beam and the measurement of energy and intensity of the charged particles, gamma rays of neutrons produced, the concentration of specific isotopes or elements can be measured quantitatively. The sensitivity varies from a few per cent down to the order of 1 in 10^9 in special cases. Surface, depth, and microanalysis techniques were developed, mostly for light isotopes using charged particle reactions. A bibliography of papers up to the middle of 1973 is included. (auth)

20605 CHERENKOV COUNTING RATES OF RADIONUCLIDES FOR ACTIVATION ANALYSIS PURPOSES. Guzzi, G.; Pietra, R.; Sabbioni, E.; Girardi, F. (EURATOM, Varese, Italy). J. Radioanal. Chem.; 20: No. 2, 751-767(1974).

Cherenkov counting efficiencies for a large number of radionuclides formed by (n,γ) reactions and used in the field of activation analysis were obtained by two different experimental procedures. A comparison between the Cherenkov counting technique and scintillation low-resolution gamma spectrometry is also presented. Results are summarized in tables and briefly discussed. (auth)

20606 SIMPLE PROGRAM IN "BASIC" LANGUAGE FOR ANALYSIS OF GAMMA-SPECTRA USING ON-LINE MINICOMPUTER. Lima, F. W.; Atalla, L. T. (Instituto de Energia Atomica, Sao Paulo, Brazil). J. Radioanal. Chem.; 20: No. 2, 769-777(1974).

A program in "INSTRUMENT BASIC" language is proposed for analysis of gamma-ray spectra obtained with Ge(Li) detectors and accumulated in multichannel analyzers on-line with minicomputers. The program locates the peaks, evaluates the corresponding energy values, the net peak areas and the standard deviations on the areas. (auth)

20607 HIGHLY SELECTIVE DIETHYLDITHIOCARBAMATE EXTRACTION SYSTEM IN ACTIVATION ANALYSIS OF COPPER, INDIUM, MANGANESE, AND ZINC. Ravnik, V.; Dermelj, M.; Kosta, L. (Univ. of Ljubljanjana, Yugoslavia). J. Radioanal. Chem.; 20: No. 2, 443-453(1974).

A versatile separation system based on the extraction of dithiocarbamates and applicable to the determination of copper, manganese, zinc, and indium in a wide selection of materials by activation analysis is described. After the dissolution of the sample and a few simple operations which eliminate specific interferences, depending on the material (e.g., sodium and gold in the NBS Standard Reference Glasses), carbamates are extracted under specific conditions by addition of appropriate complexing agents and selective stripping. Extreme separation factors permit interference-free counting using a sodium iodide detector. For example, indium is separated from a hundred thousand fold excess of manganese in the determination of the two elements in Orchard Leaves. Results are also presented for all four elements in Bowen's Kale, NBS Bovine Liver, and for Cu, In, and Mn in the 0.02 and 1 ppM SRM glasses. (auth)

20608 DETERMINATION OF MOLYBDENUM IN BIOLOGICAL MATERIALS BY COMBINED EXTRACTION OF ^{99}Mo AND ^{99m}Tc. Weers, C. A.; Van der Sloot, H. A.; Das, H. A. (Reactor Centrum Nederland, Petten). J. Radioanal. Chem.; 20: No. 2, 529-540 (1974).

Combined extraction of ^{99}Mo and its daughter-product ^{99m}Tc enables a rapid determination of molybdenum in biological samples by neutron activation analysis. A procedure and its application to standard kale powder and standard animal blood are reported. (auth)

20609 DETERMINATION OF LANTHANUM IN LARGE STEEL SAMPLES BY THE NEUTRON ACTIVATION METHOD. Jaskolska, H.; Rowinska, L.; Radwan, M. (Inst. of Nuclear Research, Warsaw). J. Radioanal. Chem.; 20: No. 2, 419-428(1974).

In view of the inhomogeneous distribution of lanthanum in steel, large samples should be used for the determination of this element. The method elaborated consists in the preparation of an average sample by dissolving 50 g of steel and analyzing an aliquot of the obtained solution corresponding to 0.5 g of steel. In order to reduce the activity of the sample, iron and some other elements are separated from the steel solution by electrolysis prior to irradiation. The amount of lanthanum contamination introduced during the pre-irradiation treatment of the sample is relatively low (10^{-10} to 10^{-9} g) if the treatment is carried out under suitable conditions. The post-irradiation treatment consists in the separation of ^{24}Na by shaking the sample solution with Sb_2O_5. The ^{140}La-activity is measured by means of a γ-spectrometer (1.0 MeV photopeak). (auth)

20610 DETERMINATION OF Rb AND Cs IN UNDERGROUND WATER BY RADIOACTIVATION. Khasanov, A. S.; Khudaibergenov, U.; Umarov, M. U. (Inst. of Hydrology and Engineering Geology, Tashkent). Dokl. Akad. Nauk Uzb. SSR; No. 7, 52-53 (1973). (In Russian).

The dried residue from a sample of underground water was irradiated 10 hr (1.8×10^{13} n/cm^2 · sec) and, after several processing steps including H_2S treatment in acid and alkali solution to remove interfering elements, the Rb and Cs were determined by their gamma spectra. The sensitivity of the method is of the order of 10^{-7} g for Rb and 10^{-8} for Cs. Results are reproducible to 10–15%. (TTT)

20611 RADIOACTIVATION ANALYSIS AND THE POSSIBILITIES OF ITS APPLICATION AT THE BORIS KIDRIC INSTITUTE OF NUCLEAR SCIENCES AT VINCA. II. Draskovic, R.; Marinkov, L.; Raskovic, R. (Boris Kidric Inst. of Nuclear Sciences, Vinca, Yugoslavia). Tehnika (Belgrade); 26: No. 8, 243-249(1972).

A review of the problems treated by the method of radioactivation analysis is presented. The following determinations have been made: (1) radioisotope contaminants which contaminate the Al cans during irradiation in pile radioactivation and during repacking in a special cell; (2) impurities which, due to the technological process of production, are present in the Al cans; (3) impurities in the suspended materials and waters in the Danube river. (Bull. Sci. Sect. A)

Chemical and Spectral Procedures

Refer also to abstracts 20694 and 23394.

20612 (CNEA-359) DETERMINATION OF FLUORIDE AND CHLORIDE IN URANIUM DIOXIDE. Separation by Pyrohydrolysis and Colorimetric Determination. Grahmann, H.; Zucal, R. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). Nov 1973. 11p. (In Spanish). INIS.

The working conditions for the determination of fluoride and chloride in uranium(IV) oxide pellets containing 1 to 100 ppM of each element are established. Fluoride and chloride are quantitatively separated from uranium(IV) oxide by pyrohydrolysis at 980°C using a regulated stream of water-saturated oxygen and collected in an alkaline solution. A fraction of this solution is used for the determination of fluoride with the lanthanon chelate of alizarin complexon and of chloride with mercury thiocynate. (auth)

20613 (CONF-730802-, pp 415-419) SPECIAL ANALYTICAL PROBLEMS IN THE ANALYSIS OF MOLYBDENUM BY ATOMIC ABSORPTION SPECTROPHOTOMETRY AND COLORIMETRIC METHODS. Meglen, R. R.; Glaze, M. L. (Univ. of Colorado, Boulder). Mar 1974.

From 1st annual NSF trace contaminants conference; Oak Ridge, Tennessee, USA (8 Aug 1973).

In proceedings of the first annual NSF trace contaminants conference.

A central analytical facility was organized to perform chemical analyses on a variety of sample types. Rocks, soils, sediments, waters, sewage, and biological samples were analyzed for molybdenum content. An interlaboratory exchange of some plant samples revealed matrix interference effects in the atomic absorption analysis for molybdenum. The interferences were removed by the addition of 1000 ppM Al to the anlyte. The importance of checking for matrix interference in atomic absorption analyses for molybdenum is emphasized. (auth)

20614 (JUL-Bibl-18) GAS CHROMATOGRAPHIC TRACE ANALYSIS IN He FROM GAS-COOLED REACTORS. A Literature Compilation. Cany, Y.; Hickert, J. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Reaktorbauelemente). Feb 1974. 40p. (In several languages). Dep. NTIS (US Sales Only) $5.00.

A compilation of approximately 300 titles from the current literature appearing from October 1970 to August 1973 is presented. (JSR)

20615 EXTRACTIVE PHOTOMETRIC DETERMINATION OF IODINE IN ROCKS. Podberezskaya, N. K.; Sushkova, V. A. (Kazakh Scientific-Research Inst. for Mineral Raw Materials, USSR). Ind. Lab. (USSR) (Engl. Transl.); 39: No. 7, 1025-1027 (Jul 1973).

Translated from Zavod. Lab.; 39: No. 7, 774-776(Jul 1973).

In the presence of bromide ions in an acid medium, iodides give an ionic associate with butylrhodamine S which can be extracted with benzene. The dye has both a colorimetric and fluorometric reaction with the iodine. This reaction was adapted for the determination of iodine in rocks. The effects of acidity, nature and concentration of addendum ion, and dye concentration were studied and the optimum conditions for the aqueous phase were selected. The effect of accompanying elements on the determination was evaluated. The conditions for the oxidation of the iodide ion were determined. The iodine was then determined by fluorescence on spectrophotometry. The reproducibility and accuracy of the method was evaluated. (JSR)

20616 PHOTOMETRIC DETERMINATION OF NIOBIUM WITH SULFONITROPHENOL M IN MINERAL RAW MATERIALS. Gerkhardt, L. I.; Okhanova, L. A.; Savvin, S. B.; Vagan, V. F. (All-Union Inst. of Mineral Raw Materials, Moscow). Ind. Lab. (USSR) (Engl. Transl.); 39: No. 7, 1019-1021(Jul 1973).

Translated from Zavod. Lab.; 39: No. 7, 769-772(Jul 1973).

The conditions for the determination of Nb with sulfonitrophenol M in sulfuric acid medium were studied and its suitability for the determination of from 0.005 to 20% Nb in loparite, hatchettolite, pigmatites, and other raw materials was demonstrated. The effects of interferring elements on the determination were evaluated. Complexone III masked all the interferring elements but Mo; however in the presence of Nb Mo does not form a colored complex with the dye and therefore does not interfere. (JSR)

20617 SPECTRAL DETERMINATION OF CERTAIN RARE IMPURITIES IN CAST IRON. Ioffe, A. Ya.; Zommer, L. R.; Mikhailova, M. E.; Pylina, V. P. (Leningrad Polytechnic Inst.). Ind. Lab. (USSR) (Engl. Transl.); 39: No. 9, 1423-1424(Sep 1973).

Translated from Zavod. Lab.; 39: No. 9, 1087-1089(Sep 1973).

The steps in the development of a method for the spectral determination of Bi, Sb, Pb, Sn, Al, Ti, Zn, V, Ce, and Cu were outlined. The method was given and the limits of determinable concentrations were tabulated. (JSR)

20618 DETERMINATION OF MOLYBDENUM IN ALLOYS IN THE PRESENCE OF TUNGSTEN BY THE METHOD OF NON-AQUEOUS TITRATION. Kreshkov, A. P.; Kuznetsov, V. V.; Bakalova, L. M.; Yakovlev, P. Ya. Ind. Lab. (USSR) (Engl. Transl.); 39: No. 9, 1382-1383(Sep 1973).

Translated from Zavod. Lab.; 39: No. 9, 1056-1057(Sep 1973).

Mo and W are both precipitated quantitatively by 8-hydroxyquinoline, but because of the differences in the acid–base properties of the hydroxyquinolinates the Mo is titrated by a solution of perchloric acid and the W does not interfere. This method was applied successfully to the determination of Mo in Mo–W alloys and in ferromolybdenum. (JSR)

20619 CHEMICAL ANALYSIS OF HIGH-TEMPERATURE, ELECTRICAL, MAGNETIC, AND OTHER SIMILAR IRON, NICKEL, AND COBALT-BASE ALLOYS. Philadelphia; American Society for Testing and Materials (1973). 15p. (ASTM-E-354-73).

The alloys may contain, among other elements, 0.01 to 6% Nb, 0.01 to 30% Mo, 0.005 to 10% Ta, 0.01 to 18% W, 0.01 to 3.25% V, and/or 0.01 to 2.5% Zr. Methods are given for determining Mn, P, S, Si, Co, Cu, C, Al, and Cr. Statistics are given on the precision of the methods. (DLC)

20620 COMPARATIVE STUDY OF METHODS OF DETERMINING NIOBIUM. Pashchenko, E. N.; Vasil'eva, L. A.; Mal'tsev, V. F.; Volkova, N. P. (All-Union Scientific-Research and Technological-Engineering Inst. of the Tube Industry, Dnepropetrovsk, USSR). Ind. Lab. (USSR) (Engl. Transl.); 39: No. 11, 1691-1695 (Nov 1973).

Translated from Zavod. Lab.; 39: No. 11, 1297-1301(Nov 1973).

The characteristics of the photometric methods using the thiocyanate ion (aqueous-acetone mixture), sulfochlorophenol S (SCPS), pyrocatechin violet, and 4-(2-pyridylazo)-resorcinol (PAR) for the determination of Nb in steel were compared. The spectrophotometric characteristics of these reagents and their complexes with Nb, the conditions for the formation of these complexes, and the effects of accompanying elements were studied on the basis of published data. The selectivity of these methods were studied using unpublished data. The comparative studies showed that the most sensitive method is based on SCPS and the most specific methods use SCPS and PAR. The interfering elements for each method were determined. (JSR)

20621 SPECTROCHEMICAL DETERMINATION OF IMPURITIES IN CERIUM OXIDE. Zmbova, B. (Boris Kidric Inst. of Nuclear Sciences, Vinca, Yugoslavia). Tehnika (Belgrade); 26: No. 4, 121-123(1972).

A direct spectrographic method was developed for the determination of 15 elements present as impurities in CeO_2 matrix. The method is based on a fractional vaporization and uses two carriers: NaF-S carrier for the determination of Pb, Ge, In, Zn, Si, Mg, V, B, Sb, Mn, and Bi, and AgCl-LiF carrier for the determination of Fe, Ni and Co. The samples were excited in a 10-A dc arc and tin was used as internal standard. (Bull. Sci. Sect. A)

20622 CHEMICOSPECTRAL DETERMINATION OF LIGHT RARE-EARTH ELEMENTS IN COMPOUNDS OF YTTRIUM AND HEAVY RARE-EARTH ELEMENTS. Vakulenko, L. I.; Kaplan, B. Ya.; Merisov, Yu. I.; Mikhailichenko, A. I.; Skripkin, G. S. (State Scientific-Research and Planning Inst. of the Rare Metals Industry, Moscow). Ind. Lab. (USSR) (Engl. Transl.); 39: No. 11, 1744-1746(Nov 1973).

Translated from Zavod. Lab.; 39: No. 11, 1342-1344(Nov 1973).

A rapid chemicospectral method for the analysis of compounds of Y, Er, Tm, Yb, and Lu for impurities of La, Ce, Pr, and Nd, based on the spectrographic determination of the impurities after solvent extraction of the base element with D2EHPA in carbon tetrachloride is given. The extraction can be carried out from both HCl and HNO_3 solution, but re-extraction from the organic phase is more readily accomplished with HCl. The trace impurities were determined by emission spectroscopy. (JSR)

20623 SPECTROPHOTOMETRIC TITRATION OF BERYLLIUM AS THE TETRAFLUOROBERYLLATE IN MIXED SOLVENTS. Kreshkov, A. P.; Kuznetsov, V. V.; Mezhlumyan, P. G. (Moscow Chemical-Engineering Inst.). Ind. Lab. (USSR) (Engl. Transl.); 39: No. 11, 1705-1707(Nov 1973).

Translated from Zavod. Lab.; 39: No. 11, 1310-1312(Nov 1973).

A method for the determination of small amounts of Be in mixed solvents, based on the reaction of BeF_4^{2-} ions in the presence of nichromazo is given. The effect of the pH of the starting solution and of the nature of the added solvents on the reaction of the ions at concentrations from 10^{-5} to 10^{-2} M was investigated. The titrimetric conditions are satisfied when carried out in the presence of acetone. The effects of foreign cations, including UO_2^{2+}, and anions on the determination were evaluated. (JSR)

20624 PHOTOMETRIC DETERMINATION OF ZIRCONIUM IN MATERIALS OF METALLURGICAL PRODUCTION WITH PICRAMINE EPSILON. Dymova, M. S.; Rybina, T. F.; Yakovlev, P. Ya.; Fridlyanskaya, E. I.; Nelina, E. A. (Central Scientific-Research Inst. of Ferrous Metallurgy, Moscow). Ind. Lab. (USSR) (Engl. Transl.); 39: No. 11, 1702-1704(Nov 1973).

Translated from Zavod. Lab.; 39: No. 11, 1307-1310(Nov 1973).

The conditions for the use of picramine epsilon for the determination of Zr in ferrotitanium, highly alloyed steels, Co–W-based alloys, and slag were determined. The determinations were made in HCl solutions. The effect of interfering elements were determined and conditions for avoiding their interference were determined. The method was tested on samples and gave good results. (JSR)

20625 AMPEROMETRIC TITRATION OF THE IODIDE ION BY POTASSIUM FERRICYANIDE. Songina, O. A.; Zakharov, V. A.; Bekturova, G. B.; Lopukhova, I. P. (Kazakh State Univ., USSR). Ind. Lab. (USSR) (Engl. Transl.); 39: No. 8, 1212-1213 (Aug 1973).

Translated from Zavod. Lab.; 39: No. 8, 920-921(Aug 1973).

The determination of the iodide ion in the presence of chloride and bromide ions by the method of amperometric titration using potassium ferricyanide was studied. In order to determine the optimum conditions for the titration, titrations were made at acidities from 0.1 to 8M H_2SO_4 and electrode potential from zero to +1.2 V (saturated calomel electrode). Under the conditions selected a quantitative determination of iodide is possible in the presence of large excesses of chloride and bromide ions. The method was used for the analysis of petroleum water and good results were obtained. (JSR)

20626 DETERMINATION OF URANIUM IN Ni ALLOYS BY PHOTOMETRIC TITRATION. Matous, K.; Tomik, B. (Inst. of Mining and Metallurgy, Ostrava, Czech.). Hutn. Listy; 28: No. 9, 663-664(Sep 1973). (In Czech).

Uranium in Ni alloys was determined by photometric titration with ammonium vanadate using phenylanthranilic acid and barium diphenylamino sulfonate as indicators, without separating Ni. Uranium was reduced by means of metallic Bi. The method of determination is described; it is rapid, simple and yields reliable results. (Nuclear Sci. Abstr. Czech.)

20627 DETERMINATION OF MOLYBDENUM BY EXTRACTION OF THE THIOCYANATE COMPLEX (EXCHANGE OF EXPERIENCE). Dolgorev, A. V.; Gushchina, I. D. (Inst. of Mineralogy, Geochemistry, and Crystal Chemistry of Rare Elements, Moscow). Ind. Lab. (USSR) (Engl. Transl.); 40: No. 1, 34-35(Jan 1974).

Translated from Zavod. Lab.; 40: No. 1, 26-27(Jan 1974).

A chloroform solution of diphenylguanidinium was used as the extraction reagent for determination of molybdenum by extraction of the thiocyanate complex. Optimum conditions were established for the extraction. Completeness of extraction into chloroform is achieved at an acidity of 0.9–3.0 M with respect to sulfuric acid, diphenylguanidinium concentration 0.03 M, and thiocyanate 2.0–4.0 M in the initial solution. Chloroform extracts of the complex have a maximum light absorption at 470 nm; the molar extinction coefficient is increased to 21,200 (i.e., by 14% in comparison with the initial aqueous solution of the complex compound of molybdenum with thiocyanate). (UK)

20628 EXTRACTION-PHOTOMETRIC DETERMINATION OF A TRACE IMPURITY OF NIOBIUM IN PREPARATIONS OF TUNGSTEN AND VANADIUM (EXCHANGE OF EXPERIENCE). Yagnyatinskaya, G. Ya.; Nazarenko, V. A. (Inst. of General and Inorganic Chemistry, Odessa). Ind. Lab. (USSR) (Engl. Transl.); 40: No. 1, 24-25(Jan 1974).

Translated from Zavod. Lab.; 40: No. 1, 21-22(Jan 1974).

An extraction-photometric method using trihydroxyfluorones for the determination of trace amounts of niobium impurities in tungsten, vanadium, and their compounds is reported. Separation of niobium from large quantities of vanadium can be achieved by extraction with a chloroform solution of tribenzylamine after reduction of the base element. For separation of niobium from tungsten, a combination of coprecipitation of the trace impurity with ferric hydroxide, followed by extraction, is necessary. (LK)

20629 DETERMINATION OF BORON ISOTOPE RATIO BY THE SURFACE IONIZATION METHOD. Nomura, M.; Okamoto, M.; Kakihana, H. (Tokyo Inst. of Tech.). Shitsuryo Bunseki; 21: No. 4, 277-281(Dec 1974). (In Japanese).

The isotope ratio of boron was determined by the surface ionization method using a Varian MAT CH-5 mass spectrometer with sufficient accuracy. A statistical treatment of the data indicates that the value obtained by each measurement consisting of 5 blocks is precise and reproducible and its standard deviation is smaller than 0.1%. (auth)

20630 INVESTIGATION OF THE CONDITIONS OF EXTRACTION–PHOTOMETRIC DETERMINATION OF NIOBIUM IN THIN FILMS OF NIOBIUM–TITANIUM WITH THIOCYANATE AND

DIOCTYLANILINE. Godovskaya, K. I.; Babenko, A. S.; Alferov, E. A. (Kharkov Polytechnic Inst.). Ind. Lab. (USSR) (Engl. Transl.); 39: No. 10, 1531-1532(Oct 1973).

Translated from Zavod. Lab.; 39: No. 10, 1169-1171(Oct 1973).

An extraction–photometric method for the determination of Nb using dioctylaniline (DOA) hydrochloride in the presence of thiocyanate was studied. Absorption spectra of the complexes involved indicate that DOA · HCl approximately doubles the sensitivity of the thiocyanate reaction for Nb and negligibly shifts the absorption maximum into the longwave region of the spectrum. Accuracy and reproducibility were verified on solutions of various samples of Nb–Ti films by the method of additives. The relative error in the interval 20 to 80 μg Nb does not exceed 5%, the absolute error 1.7 μg. (JGB)

20631 AMPEROMETRIC DETERMINATION OF SELENIUM AND TELLURIUM IN STEELS. Ivanova, Z. I.; Ignatenko, E. G.; Tarasova, V. A. (Rostov State Univ., USSR). Ind. Lab. (USSR) (Engl. Transl.); 39: No. 10, 1543-1545(Oct 1973).

Translated from Zavod. Lab.; 39: No. 10, 1180-1182(Oct 1973).

A simple method for the titrimetric determination of Se and Te in steels was developed. A solution of Se(IV) and Te(IV) in KI was prepared, and the liberated iodine titrated with ascorbic acid. The sensitivity of the determination of Se(IV) is 10 μg/25 ml, that of Te(IV) is 15 μg/25 ml. (JGB)

20632 CHEMICOSPECTRAL DETERMINATION OF IRIDIUM, RHODIUM, AND RUTHENIUM. Kreimer, S. E.; Tuzhilina, N. V.; Rakhlina, M. L.; Stogova, A. V.; Gaeva, L. M.; Pruchai, L. P. Ind. Lab. (USSR) (Engl. Transl.); 39: No. 10, 1546-1547(Oct 1973).

Translated from Zavod. Lab.; 39: No. 10, 1182-1184(Oct 1973).

Since the precipitate formed by the precipitation of Ir, Rh, and Ru by thiourea is difficult to work with, a variation to the determination of these elements by this method was developed. After the precipitation of Ir, Rh, and Ru using thiourea, without filtering off the precipitate, copper introduced into solution or present in the sample is precipitated by sodium thiosulfate, since only a negligible portion of it is precipitated by thiourea. The precipitate is filtered, calcined to copper oxide, and analyzed spectrally. The concentration of Ir, Rh, and Ru in the copper oxide depends on the amount of precipitated copper. If the samples contain large quantities of Pt, Pd, and Au, these elements must be separated. (JGB)

20633 REDUCTIVE FUSION UNDER VACUUM FOR DETERMINATION OF OXYGEN IN RARE-EARTH METALS. Orlov, V. V.; Karpov, Yu. A. (State Scientific-Research and Design Inst. of the Rare Metals Industry, Moscow). Ind. Lab. (USSR) (Engl. Transl.); 39: No. 10, 1548-1549(Oct 1973).

Translated from Zavod. Lab.; 39: No.10, 1184-1186(Oct 1973).

A method for the determination of oxygen in Sm, Lu, Pr, Ce, and La was developed, using reductive melting under vacuum and a Cu–Ni bath instead of the previously reported Pt bath. The temperature range 1650 to 1700°C was found to offer the maximum degree of extraction of oxygen. Results of the determination compared favorably with those from isotope dilution analysis. (JGB)

20634 ATOMIC ABSORPTION DETERMINATION OF PLATINUM METALS IN NONAQUEOUS MEDIA. I. Determination of Platinum Metals After Their Extraction by Tetraoctylammonium Bromide (TOAB). Lan'ina, T. V.; Yudelevich, I. G.; Vasil'eva, A. A.; Gindin, L. M. (Inst. of Inorganic Chemistry, Novosibirsk, USSR). Izv. Sib. Otd. Akad. Nauk SSSR, Ser. Khim. Nauk; No. 7, 78-83(May 1974). (In Russian).

The atomic absorption method has been developed for determining Pt, Pd, Ir, and Ru in the samples of complex composition after their extraction by TOAB. The determination of platinum metals is carried out from organic extract. The detection limit of Pt, Pd, Ru in air–C_2H_2 flame and Ir in N_2O–C_2H_2 flame was 0.16, 0.03, 0.32 and 3.50 mg/ml, respectively. (auth)

20635 DETERMINATION OF CHLORINE IN SODIUM, URANIUM, AND THEIR COMPOUNDS BY DISTILLATION-COULOMETRIC TITRATION METHOD. Yoshida, Z.; Aoyagi, H.; Takahashi, M. (Japan Atomic Energy Research Inst., Tokai). Jap. Anal.; 23: No. 4, 374-380(Apr 1974). (In Japanese).

A distillation-coulometric titration method for the determination of traces of chlorine in sodium, uranium, and their compounds has been developed. Sodium sample (0.5 to 1 g) is decomposed with steam under reduced pressure or with moist carbon dioxide. After the decomposition of the sample, the solution is neutralized with nitric acid and acidified by adding 0.1 to 0.2 ml of concentrated nitric acid. The vessel containing the sample solution is connected with a distillation apparatus and heated at 230°C for 30 minutes. During the distillation, the chloride separated from the solution is carried with a stream of nitrogen to the tapping vessel containing 10 ml of ethanol. When the separation of chloride by the distillation is complete, 0.05 ml of 1.5 N sodium hydroxide is added to the ethanol, and the chloride is titrated coulometrically with electrogenerated silver ions. A blank is run throughout the entire procedure except the sample decomposition step. The 40 μg of chlorine added to the sample is recovered satisfactorily by the distillation at 230°C for 30 minutes. The distillation behavior of chloride in the presence of uranium is shown. The distillation rate of chloride is affected by the amount of uranium and the chloride added cannot be recovered completely. However, the chloride in uranium is collected if the distillation at 350°C for 10 minutes is repeated three times. The proposed analytical method was applied to the determination of chlorine in reagent- and reactor-grade sodium, uranium and their compounds, and typical results are given. Detection limits of the proposed method are 0.5 and 1 ppM chlorine in 2 g of sodium and 1 g of uranium, respectively. (auth)

20636 CHEMICOSPECTRAL DETERMINATION OF NON-RARE-EARTH IMPURITIES IN YTTRIUM AND ITS OXIDE. Slyusareva, R. L.; Kondrat'eva, L. I.; Peizulaev, Sh. I. Ind. Lab. (USSR) (Engl. Transl.); 39: No. 12, 1882-1884(Dec 1973).

Translated from Zavod. Lab.; 39: No. 12, 1465-1468(Dec 1973).

Two chemicospectral methods for the analysis of Y (the first for the determination of readily and medium-volatile elements and the second for the determination of impurities with low volatility) were developed. In the first Y is extracted from a 15 N HNO_3 solution with TBP. After three extractions the Y remaining in the aqueous phase is converted to the oxide and serves as the carrier for the impurities in the spectral analysis. Mg, Ca, Ba, In, Cr, Mn, Co, Ni, Cu, Zn, Cd, Pb, Sb, and Bi are almost quantitatively concentrated in the aqueous phase. The trace impurities were determined by the method of fractional distillation in a d-c arc using gallium nitrate as the carrier. In the second method the trace impurities Al, Ti, Mo, W, Zr, Hf, Nb, and Ta were coprecipitated with yttrium hydroxide with an addition of tannin and quinine. After decomposition of the organic compounds and calcination, a concentrate of impurities based on yttrium oxide was obtained. The spectra were excited in a d-c arc. (JSR)

20637 ANALYSIS OF NICKEL-BASED ALLOYS BY MEANS OF A VACUUM QUANTOMETER. Khrustaleva, L. A.; Danilova, N. A.; Markova, L. V. Ind. Lab. (USSR) (Engl. Transl.); 39: No. 12, 1885-1887(Dec 1973).

Translated from Zavod. Lab.; 39: No. 12, 1468-1471(Dec 1973).

The modification of the vacuum quantometer Polyvac K-600 for spectral analysis in the continuous monitoring of metal in the melting of Ni-based alloys was described. With suitable modification the quantometer can be used for the quantitative determination of Fe, B, S, P, Si, Cu, Mn, Ni, Al, Ti, Mo, Cr, Nb, Mg, and Ca. Typical calibration curves are shown and the precision available is presented with tabulated data on Mn, Si, Cr, Mo, Al, Nb, Ti, and Fe. (JSR)

20638 DETERMINATION OF MOLYBDENUM AND TUNGSTEN IN BIOLOGICAL MATERIALS. Cardenas, J.; Mortenson, L. E. (Purdue Univ., West Lafayette, IN). Anal. Biochem.; 60: No. 2, 372-381(Aug 1974).

A spectrophotometric method for the quantitative determination of molybdenum and tungsten in the presence of each other in biological materials has been developed. The method involves the selective formation and extraction of the complexes of the metals with 4-methyl-1,2-dimercaptobenzene under specified conditions of acidity and temperature. Possible interference by components found in biological materials was examined and shown to be negligible. (auth)

Radiometric and Radiochemical Procedures

Refer also to abstracts 20804, 21065–21068, 21241, and 21417.

20639 (AEC-tr-7566) RADIOCHEMICAL METHOD OF DETERMINATION OF URANIUM, NEPTUNIUM, PLUTONIUM, TRANSPLUTONIUM, AND RARE-EARTH ELEMENTS IN SAMPLES OF AEROSOLS, RADIOACTIVE FALLOUT, AND SOIL. Gedeonov, L. I.; Gritchenko, Z. G.; Makarova, T. P.; Maksimova, A. M.; Stepanov, A. V. 1973. Translation of Radiokhimicheskaya Metodika Opredeleniya Urana, Neptuniya, Plutoniya, Transplutonievykh i Redkozemel'nykh Elementov v Probakh Aerozoley, Radioaktivnykh Vypadeniyakh i Pochvakh. 14p. Dep. NTIS $4.00.

This method can be used for the determination of isotopes of neptunium, plutonium, americium, curium, uranium, and rare earth elements in samples of aerosols, radioactive fallout, and soil. The method is based on the extraction of uranium VI by ether, selective separation of neptunium from plutonium III, americium, curium, rare earth elements and other fission fractions by extraction with a 5% solution of tenoyltrifluoroacetone in benzene, chromatographic separation of plutonium(VI) from trivalent actinides and rare-earth elements in a solution of 8M nitric acid with subsequent electromigration separation. The chemical yield of the elements listed above, with a reliability of 0.67, is as follows: for uranium (90 ± 3)%, neptunium (75 ± 4)%, plutonium (75 ± 4)%, americium, curium and rare-earth elements – (60 ± 5)%. The time required for the radiochemical analysis is 7 hours, including the time required for dissolving the sample, whose weight must not exceed 1 gram. The radiometric determination of the isotopic composition of the separated elements is carried out with the aid of gamma and alpha spectrometers. The sensitivity of the method in the determination of active isotopes $^{239-240}$Pu, ^{241}Am, ^{242}Cm and others is $2 \cdot 10^{-12}$ curies/g; beta-active isotopes ^{90}Y, ^{147}Pm – $5 \cdot 10^{-10}$ curies/g. (auth)

20640 (CONF-730802-, pp 165-184) DETERMINATION OF A TRACE ELEMENT MASS BALANCE FOR A COAL-FIRED POWER PLANT. Kaakinen, J. W.; Jorden, R. M. (Univ. of Colorado, Boulder). Mar 1974.

From 1st annual NSF trace contaminants conference; Oak Ridge, Tennessee, USA (8 Aug 1973).

In proceedings of the first annual NSF trace contaminants conference.

A mass balance for sixteen elements at a coal-fired power plant was determined. Samples were obtained from Unit No. 5 of the Valmont Power Plant located near Boulder, Colorado and owned by the Public Service Company of Colorado. Unit No. 5 burns low sulfur pulverized coal or natural gas and has a maximum power output of 180 megawatts. This unit is unique in that particulate emissions are controlled by a mechanical collector followed by an electrostatic precipitator in parallel with a wet scrubber. Samples were collected during three days of scrubber-precipitator performance tests. Samples included coal, bottom ash, mechanical collector hopper ash, electrostatic precipitator hopper ash, scrubber slurry, scrubber make-up water, and particulates sampled isokinetically at the inlet to the scrubber and at the outlets to the precipitator and scrubber. The variety of types of samples required the use of several different handling and preparation techniques. Concentration measurements using wet chemistry, atomic absorption spectroscopy, and x-ray fluorescence spectroscopy have allowed the calculation of a mass balance for arsenic, copper, iron, lead, molybdenum, niobium, rubidium, selenium, strontium, tin, yttrium, zinc, and zirconium and for the radioactive species lead-210, polonium-210, and radium-226. (auth)

20641 (CONF-731074-) DETERMINATION OF VERY LOW RADIOACTIVITY AND ITS APPLICATION, SUMMER SCHOOL, OCTOBER 8–12, 1973, STARA LESNA. (Ustav pro Vyzkum, Vyrobu a Vyuziti Radioisotopu, Prague (Czechoslovakia)). 1973. 273p. (In Czech).

The twelve lectures presented on the determination of very low activities are compiled. The subjects discussed are significance and general problems in the measurement and application of very low activities, basis of their measurement, measurement of very low β activity, measurement of very low activity with fast scintillation spectrometers, application of the measurement of very low ^{14}C and ^{3}H activities, determination of low activities in biological samples, spectrometry of low γ activity and possible applications, measurement of very low α activity and its application in geology, and counting statistics in the measurement of radioactivity. (JSR)

20642 (IEA-304) RADIOTRACER DETERMINATION OF THE WEIGHT OF MERCURY IMMOBILIZED IN ELECTROLYTIC CELLS. Szulak, C.; Said, M.; Ohara, T.; Castagnet, A.; Sanchez, W. (Instituto de Energia Atomica, Sao Paulo (Brazil)). Aug 1973. 52p. (In Portuguese). Dep. NTIS (US Sales Only) $5.75.

The mercury content immobilized in the electrolytic cells of a soda Solvay factory was measured by the radioisotopic dilution technique using ^{203}Hg as tracer (half-life 46,6 days; 81,5% of γ rays with 279,2 keV). The work was accomplished in two stages: 1) a preliminary study restricted to only two cells; 2) simultaneous measurement in the 72 cells of the Eletro Cloro's facility. The first test was intended for: a) investigating possible effects of a slow tracer diffusion into the amalgamated mercury layers, into the cell walls and bottom; b) determining the accuracy and precision of the employed system, as a function of the tracer activity and the measuring time; c) evaluating the requirements for the simultaneous measurement of 72 cells. In order to clarify point a), the measurements were carried over 48 days. During that period, mercury was neither added to, nor extracted from the two cells, to avoid disturbances in the diffusion process, and errors in subsequent calculations. The standard error for a single determination of mercury weight resulted in ±1.6%. The statistical fluctuations of the radioactive decay are the major sources of error. Within that tolerance, and after 24 hours from the injection of the radioactive mercury in the cells, no effect of the ^{203}Hg slow diffusion into the amalgam, was noticed. The preliminary study helps the planning and execution of the second stage, consisting in the simultaneous measurement of the mercury content in each one of the operating cells. In this case, the mercury weight for each cell was determined with an error less than ±0.5%, for 95.5% of confidence limit (2 σ error). This second part of the work, is described in the Appendix of the present report. (auth)

20643 (N-1536pm) QUANTITATIVE DETERMINATION OF PLUTONIUM IN BIOLOGICAL MATERIALS. Part I. The Analysis of Urine. Russell, E. R.; Schubert, J.; Jackson, J. A. (Chicago Univ., Ill. (USA)). 11 Jun 1946. 27p. Dep. NTIS $4.50.

Three general techniques, adsorption, solvent extraction, and coprecipitation, used in the separation of Pu from undesirable constituents are briefly discussed in connection with the radiometric analysis of urine solution for Pu. A detailed outline of each analytical method is given with a brief discussion of the applicability of the method. (auth)

20644 (NRPB-R-17) DETERMINATION OF PLUTONIUM IN URINE BY ULTRAFILTRATION. Strading, G. N.; Popplewell, D. S.; Ham, G. J. (National Radiological Protection Board, Harwell (UK)). Dec 1973. 16p. Dep. NTIS (US Sales Only) $4.00.

A rapid and inexpensive method for the determination of plutonium in urine has been developed. The principle depends on separating macromolecular plutonium species by ultrafiltration, and directly assaying the material retained on the membrane by scintillation counting. The limit of detection of the method is 0.04 pCi. l^{-1} and the analysis time excluding counting is about 2 hours. Routine assay does not require use of the isotope dilution technique although the plutonium can be characterized if necessary by a simple additional stage of analysis. (auth)

20645 (UCRL-51577 Pt.1) SYSTEM FOR PLUTONIUM ANALYSIS BY GAMMA RAY SPECTROMETRY. Part I. Techniques for Analysis of Solutions. Gunnink, R.; Niday, J. B.; Siemens, P. D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 18 Apr 1974. Contract W-7405-eng-48. 26p. Dep. NTIS $4.00.

Procedures have been developed for analysis of the isotopic abundances and total amounts of plutonium in solution. The technique involves analysis of the gamma rays emitted from the sample and uses a computer-based spectrometer system. A prototype system installed at the Savannah River Reprocessing Plant currently analyzes for ^{238}Pu, ^{239}Pu, ^{240}Pu, ^{242}Pu, and ^{241}Am when it is present. Precisions within 0.05% for ^{239}Pu and about 1% for ^{240}Pu and ^{241}Pu can be obtained in counting periods as short as 10 minutes. This is the first in a series of reports which will describe the techniques, show the system components, list and describe the computer programs, and evaluate the operating performance. (auth)

20646 (UVVVR-2) RADIONUCLIDE X-RAY FLUORESCENCE ANALYSIS. Havranek, E.; Bumbalova, A.; Svitel, J.; Dejmkova, E.; Herchl, M.; Jombik, J.; Nemcikova, A.; Cutkova, O. (Komenskeho Univerzita, Bratislava (Czechoslovakia). Farmaceuticka Fakulta). 1973. 164p. (In Slovak).

A survey is given of radiation sources, detectors and instruments used in radionuclide X-ray fluorescence analysis. Applications of the method are reviewed. The geometrical conditions of measurements, the selection of characteristic radiation, the matrix effect and its elimination are discussed. (Nuclear Sci. Abstr. Czech.)

20647 SIMULTANEOUS DETERMINATION OF THE CONCENTRATION AND ISOTOPIC COMPOSITION OF MICROCONSTITUENTS BY THE ISOTOPE DILUTION METHOD (EXCHANGE OF EXPERIENCE). Arakelyan, V. S. (Inst. of General and Inorganic Chemistry, Moscow). Ind. Lab. (USSR) (Engl. Transl.); 39: No. 7, 1091-1092(Jul 1973).

Translated from Zavod. Lab.; 39: No. 7, 825-826(Jul 1973).

The possibility of applying the isotope dilution method to the simultaneous determination of both the concentration and isotopic composition of microelements is considered. The conditions

necessary for the simultaneous determination were calculated theoretically, and equations were derived for the determination of n + 1 unknowns. The method was checked on the determination and isotopic concentration of Pb in thorite. (JSR)

20648 TESTING THE ASH CONTENT OF COAL BY RECORDING THE FORWARD-SCATTERED GAMMA RADIATION OF AMERICIUM-241. Rudanovskii, A. A.; Vasil'ev, A. G.; Onishchenko, A. M. Ind. Lab. (USSR) (Engl. Transl.); 39: No. 7, 1087-1090(Jul 1973).

Translated from Zavod. Lab.; 39: No. 7, 821-824(Jul 1973).

A method for testing the ash content of coal by recording the forward-scattered γ radiation of ^{241}Am is proposed. Calculations gave an almost ideal measuring geometry, and the dependence of the counting rate on the ash content, the humidity, occupation factor, and pyrite content of the coal ash was calculated for this geometry. They show that a number of perturbing factors can be automatically compensated. Four counters of the SI-22G type were used as detectors. The experimental relations between the count rate and the geometric parameters were determined. The primary limitation of the method was the substantial fluctuations that occur in the amount of pyrite in the coal ash. (JSR)

20649 ULTIMATE TUNGSTEN ANALYSIS IN ORE BENEFICIATION PRODUCTS USING RADIOISOTOPE X-RAY LUMINESCENT TECHNIQUE WITH ^{57}Co AND ^{147}Pm SOURCES. Bochenin, V. I. (Karaganda Polytechnic Inst., USSR). Ind. Lab. (USSR) (Engl. Transl.); 39: No. 11, 1754-1755(Nov 1973).

Translated from Zavod. Lab.; 39: No. 11, 1351-1352(Nov 1973).

An x-ray luminescent technique was developed for the on-stream determination of W in ore beneficiation streams. The W was analyzed on the basis of the K series excited by a ^{57}Co source. A ^{147}Pm source, placed beside the ^{57}Co source, was used to determine N_s, the count rate at the peak of simply scattered radiation. The N_i/N_s ratio (N_i is the count rate at the peak of the characteristic radiation), under the optimum conditions determined, is a linear function of the W concentration. The results obtained were compared with the results of chemical analyses of about 100 samples and the discrepancy between the two methods remained within 1%. (JSR)

20650 CHEMILUMINESCENCE FROM LYOPHILIZED ANIMAL ORGANS INDUCED BY ALKALINE SOLUBILIZERS IN SCINTILLATING SOLUTIONS. Laine-Boszormenyi, M.; Fallot, P. (CEN de Saclay, Gif-sur-Yvette, France). Int. J. Appl. Radiat. Isotop.; 25: No. 6, 241-248(Jun 1974). (In French).

Radioactivity measurements of lyophilized animal tissues by liquid scintillation counting may be disturbed by spurious counts induced by addition of alkaline solubilizers (hyamine-OH, NCS, Soluene) to scintillating solutions. It is confirmed that such an effect results from a chemiluminescence, the origin of which it is attempted to elucidate. It is observed that the chemiluminescence intensity depends on the length of time and temperature of storage of the lyophilisates. These facts led to a study of the possible role of auto-oxidizable substances. It is shown that the greatest part of the chemiluminescence arises from lipids and that its intensity grows with the oxidation degree of these compounds. The lipid-free fraction of the organs shows a lower chemiluminescence which does not change with time or with heating. The results are considered and suggestions are presented as to how to reduce the spurious counts in liquid scintillation counting. (auth)

20651 X-RAY FLUOROMETRIC DETERMINATION OF URANIUM IN COMPOSITE ADSORBENT. Fujii, A.; Miyai, Y.; Takagi, N.; Sugasaka, K.; Miyazaki, H. (Government Industrial Research Inst., Takamatsu, Japan). Nippon Kaisui Gakkaishi; 27: No. 6, 309-314(Mar 1974). (In Japanese).

The content of uranium in the composite adsorbent was determined by x-ray fluorescence spectrometry. A 30-mg sample was weighed into a sample holder made of polyethylene for the small amount of sample. The x-ray intensity of $UL_{\alpha 1}$ (26A 14°) was measured by fixed-time method, without preparing a briquette. When the concentration of uranium was in the range of 0.1 ~ 4 mg/g, the x-ray intensity of $UL_{\alpha 1}$ and the content of uranium indicated a calibration curve of a good straight line. The variation coefficients were 2.2 and 2.4% for the standard samples containing 0.5 and 1 mg of uranium in 1 g of the adsorbent, respectively. Titanium or zinc composing the composite adsorbent showed absorption effect for UL line. The x-ray intensity was corrected for the absorption effect by the concentration of the element determined by x-ray fluorescence spectrometry. The diverse elements from seawater were found not to affect the determination. The time required for the analysis of one sample was less than 15 minutes. The results of this method were consistent with that of a fluorometry within 10% error. (auth)

20652 USE OF NEUTRON IRRADIATION FOR ORE BENEFICIATION. Mokrousov, V. A.; Lileev, V. A.; Lagov, B. S. Gorn. Zh.; No. 6, 60-62(1973). (In Russian).

The use of neutron irradiation in the extraction of B-containing ores was studied. The process is one of neutron radiometric separation and is based on the difference in attenuation of the neutrons by ore fragments and barren rocks. Best results are obtained with ores containing $B_2O_3 < 10\%$; borosilicate ores have been successfully treated. An industrial neutron-radiometric separator is described. (Referativnyi Zh.)

20653 ION EXCHANGE METHOD OF DETERMINING CESIUM IN SEAWATER. Bondarenko, G. N.; Kalashnikova, Yu. S. Sov. Radiochem. (Engl. Transl.); 15: No. 5, 686-689(1973).

Translated from Radiokhimiya; 15: No. 5, 680-684(1973).

A method is proposed for the ion exchange isolation of ^{137}Cs from seawater by means of a ferrocyanide–organic ionite. A ferrocyanide–organic ionite based on AV-16G concentrates ^{137}Cs selectively from seawater. The concentration of ^{137}Cs in certain regions of the Atlantic Ocean was determined by the ion-exchange method. (auth)

20654 INORGANIC SORBENTS IN THE RADIOCHEMICAL ANALYSIS OF SEAWATER. I. Determination of Cesium-137 and Strontium-90. Krylov, V. N.; Gedeonov, L. I.; Rakov, N. A.; Trofimov, A. M. Sov. Radiochem. (Engl. Transl.); 15: No. 5, 660-664(1973).

Translated from Radiokhimiya; 15: No. 5, 654-658(1973).

A brief examination was made of the main principles of a method of determining radioactive ^{137}Cs and ^{90}Sr in seawater, which is based on the selective extraction of these radionuclides by inorganic sorbents. It was shown that because of their high selectivity, the use of inorganic sorbents makes it possible to simplify the analysis method substantially and to accelerate it and makes the determination of radionuclides in sea water suitable for mass measurements. (auth)

20655 INORGANIC SORBENTS IN THE RADIOCHEMICAL ANALYSIS OF SEA WATER. II. Sorption of Strontium-90 by Activated Barium Sulfate. Krylov, V. N.; Egorova, N. V.; Gedeonov, L. I.; Rakov, N. A.; Trofimov, A. M. Sov. Radiochem. (Engl. Transl.); 15: No. 5, 665-668(1973).

Translated from Radiokhimiya; 15: No. 5, 659-662(1973).

An attempt was made to use an inorganic sorbent (barium sulfate activated with calcium by thermal treatment of a mixture of barium and calcium sulfates) for selective extraction of strontium from seawater. A study was made of the effect of the composition of the charge for preparing the sorbent, the salinity and pH of the seawater, and the grain size of the sorbent on the sorption of strontium and also the kinetics of sorption and desorption of the ions absorbed. A rapid and simple method is proposed for determining the ^{90}Sr content of seawater, which is based on selective extraction of strontium by barium sulfate activated with calcium and the fact that there is a relatively simple distribution of stable strontium isotopes in seawater. (auth)

20656 INORGANIC SORBENTS IN THE RADIOCHEMICAL ANALYSIS OF SEA WATER. III. Use of Granulated Barium Sulfate for Extraction of Strontium-90. Krylov, V. N.; Egorova, N. V.; Kolosentsev, S. D.; Rakov, N. A.; Trofimov, A. M. Sov. Radiochem. (Engl. Transl.); 15: No. 5, 669-671(1973).

Translated from Radiokhimiya; 15: No. 5, 662-665(1973).

A method is proposed for preparing an inorganic sorbent which selectively sorbs strontium from seawater, namely, barium sulfate activated with calcium in a granulated form. The method is based on the use of a highly concentrated sol of silicic acid as a binder. Conditions for preparing the sorbent (the ratio of the components in granulation) and its thermal treatment were studied. The highest efficiency in strontium sorption and the highest stability in seawater are shown by sorbent samples obtained by drying granules at t = 100°C. (auth)

20657 NEUTRON YIELDS FROM URANIUM ISOTOPES IN URANIUM HEXAFLUORIDE. Sampson, T. E. (Los Alamos Scientific Lab., NM). Nucl. Sci. Eng.; 54: No. 4, 470-474(Aug 1974).

Neutron yields in UF_6 arising from the $^{19}F(\alpha,n)^{22}Na$ reaction and spontaneous fission of ^{233}U are reported. Passive neutron counting in nearly 4π geometry was used to measure the absolute yields from eight small UF_6 samples of varying isotopic composition. The specific yields for ^{234}U and ^{236}U are in excellent agreement with values calculated from thick target excitation functions for fluorine. The values of the specific yield from the four uranium isotopes are also in reasonable agreement with recent measurements utilizing a similar technique. (2 figures, 6 tables) (auth)

20658 DETERMINATION OF URANIUM AND THORIUM BY ISOTOPE DILUTION USING ALPHA SPECTROMETRY. Syromyatnikov, N. G.; Ostapova, N. V.; Yurgens, A. V. Sov. Radiochem. (Engl. Transl.); 15: No. 5, 704-708(1973).

Translated from Radiokhimiya; 15: No. 5, 697-704(1973).

Calculation formulas are given and an estimate is made of the accuracy of determining U and Th by isotope dilution on the basis of α-spectrometric measurements of $^{234}U/^{238}U$, $^{232}Th/^{230}Th$, and $^{228}Th/^{232}Th$, using as the isotopic tracers uranium enriched in ^{234}U, ^{232}U, and ^{229}Th. With an accuracy of the determination of the titer of the tracer of 0.5 to 1%, U and Th may be determined with an error of 1.5 to 3%. A higher accuracy may be obtained more readily when single isotopes are used as tracers. For samples with an undisturbed radioactive equilibrium it is sufficient to measure the ratio of the α activities of the U and Th isotopes (^{234}U as tracer) or only the Th isotopes (^{229}Th as tracer) in the mixture of the sample and tracer. The use of ^{232}U makes it possible to determine $^{234}U/^{238}U$ and the U content of the sample from measurements on one preparation. It was established experimentally that the instrument error may be neglected in the measurement of $^{234}U/^{238}U$ with an accuracy up to 0.5%. The U and Th contents were determined in zircon and rocks using as the tracer uranium with $^{234}U/^{238}U = 3.110 \pm 0.018$. For samples with a U and Th content of $n \cdot 10^{-2}$–$n \cdot 10^{-3}$% we obtained an accuracy of ~3%. The accuracy may be increased to 1.5 to 2% by using as the tracers single isotopes with their titer determined with an accuracy of ~0.5%. (auth)

20659 BEGINNINGS OF RADIOANALYTICAL CHEMISTRY. Szabadvary, F. (Technical Univ., Budapest). J. Radioanal. Chem.; 20: No. 2, 745-750(1974).

A survey is given on the development of analytical methods using radioisotopes (i.e., radioindication method, radiogravimetry, isotope dilution method, activation analysis, and radiometric titrations) as well as on fundamental counting devices. (auth)

Separation Procedures

Refer also to abstracts 20733, 20783, 20801, and 20819.

20660 (GKSS-74/E/5) DETERMINATION OF THE CHARACTERISTIC DATA OF ION EXCHANGE RESINS. Hattenbach, K.; Weiler, K. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Geesthacht-Tesperhude (F. R. Germany)). 1974. 21p. (In German). INIS.

8 figs.; 9 tabs.; 7 refs. With abstract.

One of the tasks of the EFDR-80 study is to develop a boric acid control system, which requires detailed information about the characteristic data of ion exchange resins as the separation of boric acid is to be done by ion exchangers. The maximum capacity of the two ion exchange resins Amberlite IRN-78 and Lewatite M 500 at 20°C and their saturation capacity for boric acid concentrations up to 1,000 ppM, relative to boron at temperatures from 10 to 50°C, were measured. Boric acid separation during discontinuous operation and the data describing the regeneration of the resins were determined. (GE)

20661 (LA-5568) IMPROVED TWO-COLUMN ION EXCHANGE SEPARATION OF PLUTONIUM, URANIUM, AND NEODYMIUM IN MIXED URANIUM–PLUTONIUM FUELS FOR BURNUP MEASUREMENT. Marsh, S. F.; Ortiz, M. R.; Abernathey, R. M.; Rein, J. E. (Los Alamos Scientific Lab., N. Mex. (USA)). Jun 1974. Contract W-7405-eng-36. 7p. Dep. NTIS $4.00.

Fractions of plutonium, uranium, and neodymium are separated for the isotopic-dilution, mass-spectrometric determination of burnup in mixed uranium–plutonium fuels. The separation uses two sequential ion exchange columns operated at room temperature. The major procedural operations are fuming of the sample with HF and $HClO_4$; transferring with 12M HCl to an anion exchange column; converting the effluent containing neodymium, other fission products, and americium to a nitrate medium; isolating neodymium by chromatographic elution on a second anion exchange column with a HNO_3–CH_3OH elutriant; and eluting plutonium from the first column with 0.1M HI–12M HCl followed by elution of uranium with 0.1M HCl. This procedure is an improvement of one published previously. The effects of variables upon the operations of this improved method are discussed with emphasis on ion exchange resins and column operation. (auth)

20662 (UCRL-75567) RARE EARTHS AND ION EXCHANGE. Sisson, D. H.; Mode, V. A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 21 Mar 1974. 7p. (CONF-741002-9). Dep. NTIS $4.00.

From 11th rare earth research conference; Traverse City, Michigan, USA (7 Oct 1974).

Ion exchange chromatography has been applied to Rare Earth separations for many years. The practical aspects of modern ion exchange chromatography as applied to both Rare Earth separations and separations of Rare Earths from other materials is discussed. Primary emphasis is placed on optimizing operation conditions for specific applications with respect to speed and ease of operation. (auth)

20663 EXTRACTION–PHOTOMETRIC DETERMINATION OF MOLYBDENUM IN HIGHLY ALLOYED STEELS. Bagdasarov, K. N.; Shchemeleva, G. G.; Mikalauskas, T. V. (Rostov-on-Don State Univ., USSR). Ind. Lab. (USSR) (Engl. Transl.); 39: No. 9, 1372-1373(Sep 1973).

Translated from Zavod. Lab.; 39: No. 9, 1047-1048(Sep 1973).

The conditions for determination of Mo(VI) in steels using p-nitrophenylfluorone (p-NPF) after extraction with TBP in benzene from HCl solutions were determined. The p-NPF was added directly to the organic phase and the optical density determined colorimetrically. The influence of extraneous ions was determined; the interferring effect of Fe^{3+} and Ti^{4+} can be eliminated by the introduction of sodium pyrophosphate into the acqueous phase before extraction. The method was tested on standard steel samples and the relative error was 3%. (JSR)

20664 QUANTITATIVE SEPARATION AND SUBSEQUENT DETERMINATION OF TITANIUM AND TANTALUM IN NIOBIUM PRODUCTS. Pal'nikova, T. I.; Dolgorev, A. V.; Gribova, L. I. (All-Union Scientific-Research and Planning Inst. of the Aluminum, Magnesium, and Electrode Industry, Moscow). Ind. Lab. (USSR) (Engl. Transl.); 39: No. 9, 1369-1371(Sep 1973).

Translated from Zavod. Lab.; 39: No. 9, 1045-1047(Sep 1973).

The conditions for separation and simultaneous determination of 1 to 2.5% TiO_2 and 1.5 to 10% Ta_2O_5 from oxalate-sulfate or tartrate-sulfate solutions containing up to 70 to 85% Nb_2O_5 were determined. An extraction-photometric method based on extraction with chloroform from the acid solution of a triple complex of the Ti with diantipyrylmethane and $SnCl_2$ was used for the separation of Ti from Ta and Nb. The optimum conditions for the separation were determined. The Ta is determined spectrophotometrically with pyrogallol in the aqueous phase after extraction of the Ti. The Ti was determined from the optical density of the organic phase. (JSR)

20665 Nb(V) EXTRACTION FROM CHLORIDE SOLUTIONS. Prudnikova, E. V.; Levchenko, Yu. I. (Leningrad Technological Inst.). Izv. Vyssh. Ucheb. Zaved., Tsvet. Met.; No. 1, 58-60 (1974). (In Russian).

Complex formation was studied in the system $NbCl_5$–HCl–$MeCl_x$–H_2O–TBP (Me = Al, Mg, K; TBP = tributyl phosphate). Absorption spectra showed a maximum at a wavelength of 280 nm, with Me = Al or Mg. The Al and Mg chlorides apparently have a salting out action on Nb(V) since, with increase in their concentration in the aqueous phase, the optical density of the organic phase increased. Formation of the $[Nb(OH)_2Cl_4]^-$ or $[NbOCl_4]^-$ ion may occur. (tr-auth)

20666 REDUCING THE COEXTRACTION OF TRACE ELEMENTS IN THE EXTRACTION OF INDIUM FROM BROMIDE SOLUTIONS. Sokolov, A. E. Ind. Lab. (USSR) (Engl. Transl.); 39: No. 10, 1533-1535(Oct 1973).

Translated from Zavod. Lab.; 39: No. 10, 1171-1173(Oct 1973).

The influence of indium concentration on the extraction of Te, Sb, Co, Ag, Bi, Hg, and Cd with TBP, methyl isobutyl ketone, and dichlorodiethyl ether from HBr was studied. Tracer techniques showed that the extraction of most of the elements is lower 100-fold or even 1000-fold in the presence of indium. (MCG)

20667 SORPTION OF SOME RADIOELEMENTS BY AN INORGANIC SORBENT: TIN(IV) PHOSPHATE. II. Effect of Synthesis Conditions of Tin Phosphate on Sorption of Zirconium. Krylov, V. N.; Pitalev, V. G.; Pospelov, A. A.; Trofimov, A. M. Sov. Radiochem. (Engl. Transl.); 15: No. 5, 656-659(1973).

Translated from Radiokhimiya; 15: No. 5, 650-654(1973).

A study was made of the effect of different synthesis conditions for an inorganic sorbent, namely, tin phosphate, on its capacity to sorb zirconium (IV) from nitric acid solutions. The sorption of zirconium by tin phosphate depends mainly on the structure of the sorbent, its specific surface, and the dimensions of pores. By the appropriate selection of the reaction mixture composition it is possible to synthesize sorbents with a definite pore diameter; such a directed synthesis will make it possible to obtain inorganic sorbents with a high degree of selectivity of sorption. (auth)

20668 SORPTION OF RUTHENIUM(IV) FROM SULFATE SOLUTIONS BY IRON HYDROXIDE AT ELEVATED TEMPERA-

TURE. Sinitsyn, N. M.; Borisov, V. V.; Ladygo, A. S.; Plotinskii, G. L. Sov. Radiochem. (Engl. Transl.); 15: No. 5, 652-655(1973).
Translated from Radiokhimiya; 15: No. 5, 645-649(1973).

A study was made of the sorption of tetravalent ruthenium in the form of hydroxo aqua complexes from sulfate media by iron hydroxide at an elevated temperature. It was shown that quantitative extraction of ruthenium(IV) from sulfate media by iron hydroxide is possible with a ratio Fe:Ru ≥ 1000 over a wide pH range (from 3 to 10). It was established that the presence in the system of sulfate ion (up to 100 g/liter) and the cations Cu^{2+}, Ni^{2+}, and Co^{2+} (up to 11 g/liter) does not have substantial effect on the percentage sorption. (auth)

20669 COPRECIPITATION OF FISSION PRODUCTS WITH MAGNESIUM HYDROXIDE. II. Coprecipitation of Ca, Br, Rb, Rh, Pd, Ag, In, Sn, Te, I, and Ba. Novikov, A. I.; Ruzankin, V. I. Sov. Radiochem. (Engl. Transl.); 15: No. 5, 647-651(1973).
Translated from Radiokhimiya; 15: No. 5, 641-645(1973).

Conditions were found for the concentration of a series of fission products, namely, Y, Ce, Cd, Ga, In, As, Zr, Nb, and Rh, by coprecipitation with magnesium hydroxide in solutions of ammonium nitrate and bicarbonate and in the presence of hydrogen peroxide. The experimental conditions were found under which such fission products as Rb, Cs, Sr, Ba, As, Se, Br, I, Mo, Ag, Pd, and Te are not coprecipitated with magnesium hydroxide. (auth)

20670 SORPTION SYSTEM. Seawater–Sediment–Radioactive isotope. Shchebetkovskii, V. N.; Kuznetsov, Yu. V.; Tarlakov, Yu. P. Sov. Radiochem. (Engl. Transl.); 15: No. 5, 672-676(1973).
Translated from Radiokhimiya; 15: No. 5, 665-671(1973).

An investigation was made of the effect of a change in the composition of the liquid and solid phases on the distribution of ^{137}Cs and ^{144}Ce in the sea water–sediment system. Qualitative changes in the mineral composition of the liquid phase, the introduction of organic components, and preliminary extraction of the sediments do not lead to a change in the sorption of ^{137}Cs, but have a complex effect on the distribution of ^{144}Ce. The character of the changes occurring in the sediments during extraction with distilled water is discussed and the nature of the extracts thus obtained is established on the basis of IR spectrometric data. (auth)

20671 n-BUTANOL EXTRACTION OF Mo AND W FROM PRODUCTS OF THEIR DISSOLUTION IN HYDROGEN PEROXIDE. Artykbaev, T.; Ganiev, Sh. U.; Tsyganov, G. A.; Alimbaeva, N. (Inst. of Chemistry, Tashkent). Dokl. Akad. Nauk Uzb. SSR; No. 12, 16-17(1973). (In Russian).

Molybdenum and tungsten were extracted by n-butanol at suitable pH values from solutions of their dissolution in hydrogen peroxide. At pH 0–2, considerable molybdenum peroxide appeared in the organic phase, which was intensely blue. At pH greater than 2, the amount in the organic phase dropped sharply, and the color changed to brownish blue. Tungsten was extracted at pH 0–0.5, and extraction decreased sharply at pH greater than 1. At pH of 1 or greater the tungsten acid peroxide was stable for 24 hr but then began to decompose, with a decrease in pH, to a subcolloidal tungsten acid. (TTT)

20672 EXTRACTION AND SEPARATION OF ^{60}Co AND ^{65}Zn HALIDES FROM H_2SO_4 WITH TBP AND AMBERLITE LA-2. Alian, A.; Haggag, A.; Sanad, W. (Atomic Energy Establishment, Cairo). J. Radioanal. Chem.; 20: No. 2, 559-573(1974).

A systematic study is presented on the extraction of ^{60}Co and ^{65}Zn bromides and chlorides from H_2SO_4 with tri-n-butyl phosphate (TBP) and Amberlite LA-2. The presence of a little HBr or HCl enhances the extraction of the two isotopes with both solvents. The extractions of ^{60}Co and ^{65}Zn were studied as functions of the acidity (HBr, HCl, or H_2SO_4) in the aqueous phase, and of the diluent and solvent concentrations in the organic phase. The presence of water-miscible alcohols or acetone enhances extraction. A suggested extraction mechanism is presented in the light of the obtained results. (auth)

20673 POSSIBILITY OF THE FORMATION OF COMPLEXES OF URANIUM(VI) IN ORGANIC SOLUTIONS. Vdovenko, V. M.; Vavilov, N. G. Sov. Radiochem. (Engl. Transl.); 15: No. 5, 757-759(1973).
Translated from Radiokhimiya; 15: No. 5, 750-652(1973).

The purpose of this work was to check experimentally whether uranium(VI) compounds of the type $(UO_2X_2)_n$ and $UO_2(NO_3)_2 \cdot 2TBP$ react in organic solutions and if so, to attempt to establish the approximate composition of the compounds formed. The check consisted of mixing different combinations of organic solutions of di-n-heptylphosphinic acid and TBP with and without uranium(VI) and studying the changes occurring in the IR spectra of the mixtures formed. An IKS-14 spectrophotometer with a NaCl prism and KBr cells was used to measure the IR spectra of the compounds. (LK)

20674 PREPARATION OF HIGH-PURITY MAGNESIUM OXIDE. II. Removal of Trace Amounts of Impurities from Magnesium Nitrate Solutions. Debska-Horecka, A. (Technical Univ., Gilwice, Poland); Kulik, J.; Stronski, I. J. Radioanal. Chem.; 20: No. 2, 639-648(1974).

Investigations on the separation of trace amounts of Ba, Mn, Fe, Sr + Y, Co, Ca, Zn, Ag and Na from macro-amounts of Mg are described. (auth)

20675 EXTRACTION-CHROMATOGRAPHIC SEPARATION OF URANIUM FROM LONG-LIVED FISSION PRODUCTS USING TRIBUTYL PHOSPHATE. Tamura, N.; Yonezawa, C. (Japan Atomic Energy Research Inst., Tokai). J. Radioanal. Chem.; 20: No. 2, 455-462(1974).

Extraction-chromatographic separation of uranium from fission products was performed using undiluted tributyl phosphate sorbed on Chromosorb W as a stationary phase, and nitric acid (1:3) as a mobile phase. Most of the fission products that contributed greatly to the radiation level of the sample passed through the column; this effected considerable decontamination. Uranium retained on the column was quantitatively recovered by elution with water. (auth)

20676 ELECTRODIALYSIS OF FORMIC ACID-METHANOL SOLUTIONS OF RADIORUTHENIUM USING ION-EXCHANGE MEMBRANES. Volkov, A. A.; Filatov, E. S. Sov. Radiochem. (Engl. Transl.); 15: No. 5, 751-753(1973).
Translated from Radiokhimiya; 15: No. 5, 745-747(1973).

The behavior of ^{106}Ru in the electrolysis of formic acid–methanol solutions (pH = 0.25–5.0) with ionite membranes was investigated. The fall in the total rate of migration of anionic forms of radioruthenium can be ascribed almost completely to a decrease in concentration. A change in the acidity of the solutions investigated has little effect on the migration of the relative amounts of radioruthenium in the cationic forms. (LK)

20677 CONCENTRATION OF ^{106}Ru WITH IRON AND ALUMINUM HYDROXIDES BY FOAM FORMATION. Evtyukhova, O. V.; Nikiforov, A. F.; Berezyuk, V. G.; Pushkarev, V. V. Sov. Radiochem. (Engl. Transl.); 15: No. 5, 748-750(1973).
Translated from Radiokhimiya; 15: No. 5, 743-745(1973).

A study was made of the extraction of ^{106}Ru from aqueous media with aluminum and iron hydroxides by foam flotation. Alkyltrimethylammonium chloride and alkylbenzyldimethylammonium chloride were used as foam formers. It was shown that the sorption of ^{106}Ru by the hydroxides studied when isolated from the solution in a foam is described by Henry's distribution. (auth)

20678 SORPTION OF RUTHENIUM(IV) FROM SULFATE SOLUTIONS BY COPPER SULFIDE. Sinitsyn, N. M.; Borisov, V. V.; Dobronravov, S. A.; Rovinskii, F. Ya.; Ladygo, A. S. Sov. Radiochem. (Engl. Transl.); 15: No. 5, 745-747(1973).
Translated from Radiokhimiya; 15: No. 5, 741-742(1973).

A study was made of some factors which affect the sorption of ruthenium(IV) in the form of hydroxoaquo complexes from sulfate solutions by copper sulfide. It was found that an increase in the temperature at which the process is carried out increases the rate at which equilibrium is reached. It was shown that with a solution acidity less than 0.01 M H_2SO_4 and a ratio Cu:Ru ≥ 1500 more than 95% of the ruthenium is extracted. With an increase in the sulfuric acid concentration the extraction of Ru(IV) falls. (auth)

20679 COPRECIPITATION OF MICROAMOUNTS OF ^{89}Sr WITH ALKYLBENZYLDIMETHYLAMMONIUM PHOSPHOTUNGSTATE. Nikiforov, A. F.; Pushkarev, V. V.; Evtyukhova, O. V.; Berezyuk, V. G. Sov. Radiochem. (Engl. Transl.); 15: No. 5, 741-744(1973).
Translated from Radiokhimiya; 15: No. 5, 738-740(1973).

It was shown that the coprecipitation of microamounts of ^{89}Sr with an alkylbenzyldimethylammonium phosphotungstate has an ion-exchange mechanism. (auth)

20680 INTERACTION OF DI-2-ETHYLHEXYLPHOSPHORIC ACID AND ITS URANYL SALT WITH DILUENTS. III. Effect of Diluents on Extraction. Rozen, A. M.; Yurkin, V. G. Sov. Radiochem. (Engl. Transl.); 15: No. 5, 763-765(1973).
Translated from Radiokhimiya; 15: No. 5, 754-756(1973).

It was shown that the effect of diluents on the extraction of uranyl by HDEHP predicted from data on the activity coefficients in the binary systems HDEHP–diluent and the salt $UO_2(HR_2)_2$–diluent agrees well with extraction data. It was shown that al-

though the main reason for the nonideality of the binary systems is the athermal effect, the effect of diluents on extraction is determined by small, but incompletely compensated chemical interactions in the binary systems. The reasons are given for the change in order and magnitude of the effect of diluents on the extraction of uranium with a change from TBP to HDEHP. (auth)

20681 EXTRACTION OF URANIUM(VI) FROM PERCHLORIC ACID SOLUTIONS BY ACID AND NEUTRAL ORGANOPHOSPHORIC COMPOUNDS. Vavilov, N. G. Sov. Radiochem. (Engl. Transl.); 15: No. 5, 760-762(1973).

Translated from Radiokhimiya; 15: No. 5, 752-754(1973).

Di-(2-ethylhexyl)phosphoric acid, di-n-heptylphosphinic acid, and tri-n-butyl phosphate were investigated as extractants for the uranyl ion by a solvate mechanism. (LK)

20682 STATICS OF Mo SORPTION ON ANIONITE AV-17 WITH DIFFERENT CONCENTRATIONS OF HCl AND CHLORIDE ION. Umarakhunov, M. Kh.; Shamsiev, S. M. Dokl. Akad. Nauk Uzb. SSR; No. 11, 35-36(1973). (In Russian).

Studies on recovery of Mo from industrial effluents showed that molybdate ion is extracted by strongly basic anion exchangers only at pH 3-5. Sorption data indicated an isoelectric point at pH 1 and electromigration data indicated one at pH 0.5, which agree with published data. Increasing chloride ion content decreased the sorption. (TTT)

Inorganic, Organic, and Physical Chemistry

Chemical and Physicochemical Properties

Refer also to abstracts 20785, 20795, 20802, 21311, 21566, 21567, 21579, 21604, 22504, and 22505.

20683 (BARC-700) NORMAL COORDINATE ANALYSIS OF METHYL AMINE AND ITS DEUTERATED SPECIES. Ghodgaonkar, G. S. (Bhabha Atomic Research Centre, Bombay (India). Spectroscopy Div.). 1973. 10p. Dep. NTIS (U. S. Sales Only) $4.00.

A normal coordinate analysis of methyl amine and its deuterated derivatives (6 molecules) is reported assuming valence force field (VFF). Initially, for the first set of calculations, the symmetry axis of the methyl group was assumed to be coincident with the CN direction. Later on, calculations were repeated for the actual structure of methyl amine, where the symmetry axis of methyl group makes an angle of 3°30′ with the CN direction. The structural parameters used in these calculations are: d_{C-H} = 1.093Å (assumed), d_{C-N} = 1.474 ± 0.005Å; d_{N-H} = 1.014Å (assumed), ∠HCH = 109°30′ ± 1°; ∠HNH = 105°50′ ± 1°; ∠CNH = 112°10′ ± 1°; and the angle between the symmetry axis of the methyl group and C-N direction being 3°30′ ± 10′ (the symmetry axis of methyl group passes through the NH_2 triangle). (auth)

20684 (BNWL-CC-1381) RATE CONSTANTS FOR THE REACTION OF CARBON DIOXIDE AND WATER VAPOR WITH KC GRAPHITE. Giberson, R. C. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). [nd]. Contract AT(45-1)-1830. 13p. Dep. NTIS $4.00.

Rate constants for the C + CO_2 reaction and the C + H_2O reaction are presented for KC graphite. The inhibiting effect of CO and H_2 on the CO_2 and H_2O reactions, respectively, is also shown. KC graphite is found to oxidize about three times as fast as TSX graphite for the CO_2 reaction and about equal to TSX graphite for the H_2O reaction. (auth)

20685 (FRNC-TH-494) SUPERCOOLING OF HEAVY WATER. Lere-Porte, M. (Pau Univ., 33 (France)). 1970. 147p. (In French). Dep. NTIS (US Sales Only) $10.50.

Thesis.

Freezing temperatures were determined and comparisons made between the behaviors of heavy water and ordinary water. The supercooling of H_2O-D_2O and KCl–D_2O binary systems is also discussed. The existence of hyperfreezing curves was established, these curves representing limits associated with the threshold rupture limits for supercooled heavy water. The use of conductometry and refractometry to study the behavior of the KCl–D_2O binary system during cooling is discussed. The existence was established of true transitions to the liquid state consistent with the occurrence of cooperative phenomena which precede and prepare the freezing of the solution. (FR)

20686 (IS-M-20) SURVEY OF SOME PROPERTIES OF AQUEOUS RARE EARTH SALT SOLUTIONS. I. Volume, Thermal Expansion, Raman Spectra, and X-Ray Diffraction. Habenschuss, A.; Spedding, F. H. (Ames Lab., Iowa (USA)). 1974. (CONF-741002-5). Dep. NTIS $4.00.

From 11th rare earth research conference; Traverse City, Michigan, USA (7 Oct 1974).

Data showing the most significant trends in the study of aqueous solutions of very soluble rare earth chlorides, perchlorates, and nitrates are presented. The densities, partial molar volumes, coefficients of thermal expansion, apparent molal expansibilities and some Raman and x-ray studies are considered. (JSR)

20687 (IS-M-21) SURVEY OF SOME PROPERTIES OF AQUEOUS RARE EARTH SALT SOLUTIONS. II. Heats of Dilution, Heat Capacities, Activity Coefficients, Electrical Conductances, and Relative Viscosities. Rard, J. A.; Spedding, F. H. (Ames Lab., Iowa (USA)). 1974. 10p. (CONF-741002-8). Dep. NTIS $4.00.

From 11th rare earth research conference; Traverse City, Michigan, USA (7 Oct 1974).

Data showing the most significant trends in the study of aqueous solutions of very soluble rare earth chlorides, perchlorates, and nitrates are presented. Thermodynamics and transport properties at 25°C are considered in the present paper. (JSR)

20688 (UCRL-13598) GASEOUS METAL HYDROXIDES AT HIGH TEMPERATURES. Final Report for the Year Ended November 15, 1973. Carpenter, J. H. (Saint Cloud State Coll., Minn. (USA). Dept. of Chemistry). 1973. 11p. Dep. NTIS $4.00.

For Univ. of California. Lawrence Livermore Lab.

Transport of metals and metal oxides as gaseous metal hydroxides constitutes an important practical problem in the dispersion of metals such as fission products to the environment. The objective of this study is to identify the gaseous metal hydroxide species that exist and determine their thermodynamic properties. The lead hydroxide system was the first system to be studied. Last year a transpiration apparatus was set up and preliminary studies were done on lead transport. This year improvements were made on the apparatus and ten additional transpiration runs were made. The data from runs made this year showed much less scatter than earlier data. Flow rate conditions were determined at which saturation of the carrier gas steam was complete and diffusion of the volatile species was minimized. Assuming that the gaseous species is $Pb(OH)_2$ an equilibrium constant of 1.2×10^{-7} was found for the reaction: PbO(s) + H_2O(g) = $Pb(OH)_2$(g) at 973°K. Using the above data the enthalpy of dissociation of $Pb(OH)_2$(g) to Pb(g) and 2OH(g) at 298°K is 135 kcal/mole. Determination of the vapor species using the present apparatus appears to be impractical because of the small amount of lead transport that can be obtained. Alternative methods should be explored. (auth)

20689 (ZfK-253) GASEQUILIBRIUM OF THE SYSTEM F–O–H. Gruenberg, H.; Mueller, E. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). May 1973. 102p. (In German). Dep. NTIS (US Sales Only) $8.25.

Using a computer table data for the gas equilibrium of the systems F–O–H, F–O, F–H and O–H were calculated. These tables can be used for the construction of phase diagrams of the Baur–Glaessner-type. By the help of the examples of heterogeneous systems U–O–H, U–F–H and U–F–O–H the use of the tables is shown. (auth)

20690 MODIFIKATSIYA SVOISTV POLIMEROV. (Modification of the Properties of Polymers). Tarnopol'skii, Yu. M. (ed.). Riga; Izdatel'stvo Zinatne (1974). 168p.

A series of articles on the modification of polymer properties is compiled. The results of studies on the preparation, formation mechanisms, and stabilization of the rheological and adhesion properties of the modified, impregnated, and composite materials are reported. A separate abstract was prepared for one article. (tr-auth)

For an abstract of an individual paper see: 20752.

20691 PREPARATION AND CRYSTALLOGRAPHIC AND SPECTRAL PROPERTIES OF THE OCTAHEDRAL HEXAFLUOROPROTACTINATE(IV) $(NEt_4)_2PaF_6$. Brown, D.; Whittaker, B.; Edelstein, N. (Atomic Energy Research Establishment, Harwell, Eng.). Inorg. Chem.; 13: No. 8, 1805-1808(Aug 1974).

Bis(tetraethylammonium) hexafluoroprotactinate(IV) has been prepared in both cubic and tetragonal crystal modifications by reactions in oxygen-free propylene carbonate. The tetragonal (β) phase is isostructural with the uranium(IV) analog which appears to exist in only one modification. Solid-state transmission spectra indicate that both α- and β-$(NEt_4)_2PaF_6$ exhibit octahedral stereochemistry and the results are interpreted in terms of two ligand field parameters and the spin-orbit coupling constant. The values obtained are compared with those available for other octa-

hedral 5f¹ compounds. Infrared data are reported for both crystal modifications of $(NEt_4)_2PaF_6$ and for β-$(NEt_4)_2UF_6$. (auth)

20692 CHARACTERIZATION OF SOLID SURFACES. Kane, P. F.; Larrabee, G. B. (eds.). New York; Plenum Publishing Corporation (1974). 686p. $32.50.

An exhaustive report is given on the methods and techniques used for the evaluation of the surface of solids. The work is divided into two sections—physical and chemical. The physical methods discussed are light microscopy, multiple-beam interferometry, stylus techniques, electron microscopy, scanning electron microscopy, field ion microscopy, and x-ray diffraction methods. The chemical methods are electrochemical techniques, emission spectroscopy, internal reflection spectroscopy, radioisotope techniques, x-ray fluorescence analysis, surface characterization by electron spectroscopy for chemical analysis, resonance methods, Moessbauer spectroscopy, Rutherford scattering, accelerator microbeam techniques, electron probe microanalysis, x-ray emission fine features, analytical Auger electron spectroscopy, mass spectroscopy, impurity-movement problems in analysis methods using particle bombardment, and surface composition by analysis of neutral and ion impact radiation. These two groups of methods emphasize the two subsets of materials characterization, structural and compositional. Each chapter contains a bibliography. Individual abstracts were written for four chapters. (JSR)

For abstracts of individual chapters see: 20693–20696.

20693 RADIOISOTOPE TECHNIQUES. Keenan, J. A.; Larrabee, G. B. (Texas Instruments, Inc., Dallas). pp 247-273 of Characterization of Solid Surfaces. Kane, P. F. (ed.). New York; Plenum Publishing Corporation. (1974).

Radioisotope techniques offer two types of information in the characterization of surfaces. Activation analysis provides a means for determining the chemical impurities at or near the surface. When coupled with autoradiography, activation analysis can provide both quantitative data on concentration as well as topographic localization of the impurity sites. Radiotracer techniques provide indirect characterization of the chemical nature and composition of the surface. They provide insight into the role of chemical or physical species at the surface during processes such as adsorption–desorption, corrosion, and catalytic activity. Here particularly, autoradiography is essential to understanding the radiotracer characterization of the surface. (43 references) (auth)

20694 X-RAY FLUORESCENCE ANALYSIS. Gilfrich, J. V. (Naval Research Lab., Washington, DC). pp 275-306 of Characterization of Solid Surfaces. Kane, P. F. (ed.). New York; Plenum Publishing Corporation (1974).

X-ray fluorescence analysis is presently accepted as one of the most useful, rapid, and economic analytical methods available. The principles of the method, excitation methods used, and measurement techniques are described. The absorption criterion and surface thickness as a function of atomic number and wave length are considered in the definition of "surface" to an x-ray photon. Examples of the application of this method to the analysis of surfaces are given. (41 references) (JSR)

20695 MOESSBAUER SPECTROSCOPY. Hobson, M. C. Jr. (Virginia Inst. for Scientific Research, Richmond). pp 379-401 of Characterization of Solid Surfaces. Kane, P. F. (ed.). New York; Plenum Publishing Corporation (1974).

The application of the Mössbauer effect to surface studies has produced several significant contributions to the field. A new technique for the measurement of crystallite size and size distribution has been developed around the observation of the superparamagnetic transition in magnetically ordered materials. Strong evidence for the interaction of iron oxide deposits with "inert" support materials has been obtained from studies of the superparamagnetic transition of α-Fe_2O_3 and the resistance to reduction of iron oxides by hydrogen as a function of typical pretreatment conditions of catalyst preparations. The observations of interaction with support materials have also shown the presence of species not previously identified by other experimental techniques. Chemisorption studies have revealed the formation of surface complexes with certain similarities to transition metal complexes in solution. Finally, investigations of the dynamics of motion of surface atoms have shown that cations on the surface of silica gel are located in sites in which their displacement normal to the surface is greater than parallel to the surface. Future prospects for surface studies look very encouraging despite the limitation of the technique to only a few of the elements. Applications may be anticipated in the growing area of ferrite catalysts and in corrosion studies where some of the newest innovations in instrumentation should find extensive use. (67 references) (auth)

20696 ACCELERATOR MICROBEAM TECHNIQUES. Pierce, T. B. (Atomic Energy Research Establishment, Harwell, Eng.). pp 419-439 of Characterization of Solid Surfaces. Kane, P. F. (ed.). New York; Plenum Publishing Corporation (1974).

The analytical methods used in surface characterization by accelerator microbeams are summarized. The production of microbeams is described. Experimental techniques are outlined and examples are given of the use of charged particle microbe techniques. (36 references) (JSR)

20697 STUDY OF THE EXISTENCE OF UNKNOWN AND UNSTABLE COMPOUNDS THROUGH MIXED CRYSTAL FORMATION USING RADIOACTIVE TRACERS. Purkayastha, B. C.; Das, N. (Saha Inst. of Nuclear Physics, Calcutta). J. Radioanal. Chem.; 20: No. 2, 489-497(1974).

A heterogeneous distribution study with internally formed lead chromate as host and ^{110}Ag as guest indicates the existence of a new variety of lead chromate, which forms mixed crystals with silver chromate, and differs in morphology from the aged variety. It is inferred that the formation of mixed crystals is probably due to breeding of a morphologically analogous and unstable species by the guest component. By means of study of the homogeneous distribution coefficient, D, of the system consisting of $KFe(SO_4)_2 \cdot 12\ H_2O$ as host and ^{110}Ag as guest, the existence of an unknown alum, $AgFe(SO_4)_2 \cdot 12\ H_2O$, in trace amounts has been demonstrated. A distribution study of the system shows that $KFe(SO_4)_2 \cdot 12\ H_2O$ forms mixed crystals with ^{110}Ag up to 10°C, after which the uptake follows an adsorption pattern. The transition temperature of the guest alum, indicated by a sharp change in the D values, is found to be 10°C. Application of radioactive tracers in the study of new and unstable compounds have been stressed. (auth)

Isotope Effects

Refer also to abstracts 20733 and 20796.

20698 ORIGIN OF THE CHEMICAL-SHIFT ISOTOPE EFFECT. Stereochemical Evidence. Lambert, J. B.; Greifenstein, L. G. (Northwestern Univ., Evanston, IL). J. Amer. Chem. Soc.; 96: No. 16, 5120-5124(7 Aug 1974).

The chemical shift of a fluorine-19 nucleus moves to higher field when deuterium is substituted for hydrogen either geminally (H – C – F → D – C – F) or vicinally (H – C – C – F → D – C – C – F). It was found that the vicinal chemical-shift isotope effect has a strong stereochemical dependence. When the H(D) – C – C – F dihedral angle is less than 90°, the isotope shift is about 0.15 ppM. When the nuclei are furthest apart, at 120 and 180°, the isotope shift increases to about 0.35 ppM. These results cannot be explained exclusively in terms of an electric-field model, which predicts an inverse dependence of the magnitude of the effect on the distance between the resonating and perturbing nuclei. Because the stereochemical dependence is similar to that observed for substituent inductive effects on the absolute magnitude of vicinal coupling constants and chemical shifts, it is concluded that a major portion of the isotope shift results from vibrationally based inductive effects. Vicinal (σ) delocalization provides one mechanism for such a phenomenon. (auth)

20699 COMPETITIVE Ar_1-5 AND Ar_2-6 PARTICIPATION IN THE FORMOLYSIS OF 4-ARYL-N-BUTYL P-BROMOBENZENESULFONATES. Jackman, L. M.; Haddon, V. R. (Pennsylvania State Univ., University Park). J. Amer. Chem. Soc.; 96: No. 16, 5130-5138(7 Aug 1974).

The mechanism of aryl participation in the formolysis of 4-aryl-n-butyl p-bromobenzenesulfonates was elucidated by the study of suitably deuterated substrates. The formolysis of 4-(p-methoxyphenyl)-n-butyl-2,2-d_2p-bromobenzenesulfonate proceeded 74.2% by Ar_1-5 and 25.8% by Ar_2-6, in contrast to earlier assumptions of an exclusive Ar_1-5 pathway. The formolysis of the bromobenzenesulfonate of 4-(p-tolyl)-n-butyl-3,3,4,4-d_4 alcohol was also investigated, and in this system the Ar_2-6 pathway was shown to be preferred (69.4%). It is concluded that Ar_2-6 is inherently preferred over Ar_1-5, but not to so large an extent as to explain the complete specificity of cycloacylation reactions. The hydrogen-deuterium kinetic isotope effects for chromic acid oxidation of 6-methyltetralin to 6- and 7-methyl-α-tetralones were determined to be 3.4 and 3.8, respectively. (auth)

20700 FORMOLYSIS OF 4-(P-METHOXYPHENYL)BUTYL P-BROMOBENZENESULFONATE. Gates, M.; Frank, D. L.; von Felten, W. C. (Univ. of Rochester, NY). J. Amer. Chem. Soc.; 96: No. 16, 5138-5143(7 Aug 1974).

That fraction of the formolysis of 4-(p-methoxyphenyl)butyl p-bromobenzenesulfonate leading to 6-methoxytetralin proceeds through a symmetrical intermediate to the extent of 69.5% and through an unsymmetrical intermediate to the extent of 30.5%. The

secondary deuterium isotope effect for the partition of the symmetrical intermediate is about 10%. (auth)

20701 VIBRATIONAL SPECTRA, METAL ISOTOPE EFFECT, AND NORMAL COORDINATE ANALYSIS OF TRANSITION METAL COMPLEXES OF SIMPLE SULFUR-CONTAINING LIGANDS. Mueller, A. (Univ. of Dortmund, Germany); Heinsen, H. H.; Christophliemk, P.; Nakamoto, K.; Cormier, A. pp 143 of Proceedings of the XVth International Conference on Coordination Chemistry. Moscow; Izdatel'stvo Nauka (1973).

From 15th international conference on coordination chemistry; Moscow, USSR (25 Jun 1973). See CONF-730638-.

Novel complexes were prepared with the ions MoS_4^{2-}, WS_4^{2-} and WSe_4^{2-} acting as ligands. These complexes contain the bridging systems $S_2MS_2M''S_2MS_2$ (M = Mo, W; M = transition metal). The infrared and Raman spectra of these compounds are reported. Spectra of the substances with metal isotopes such as ^{92}Mo-^{100}Mo, ^{64}Zn-^{68}Zn, ^{58}Ni-^{62}Ni (in some cases, e.g. $[Ni(MoS_4)_2]^{2-}$ with isotopes of the different metals) were studied. The complexes with $WO_2S_2^{2-}$ are reported. The spectra and force constants of trithiocarbonato complexes of transition metal complexes of ^{64}Zn, ^{68}Zn, ^{58}Ni and ^{62}Ni were studied. (auth)

20702 SECONDARY ISOTOPE EFFECTS ON THE IONIZATION OF 2-NITROPROPANE. Kresge, A. J.; Drake, D. A.; Chiang, Y. (Illinois Inst. of Tech., Chicago). Can. J. Chem.; 52: No. 10, 1889-1896(15 May 1974).

The equilibrium isotope effect on the acid dissociation of 2-nitropropane in wholly aqueous solution at 25°C was found to be $K_H/K_D = 1.23 \pm 0.03$ for complete deuteration of both methyl groups; the kinetic isotope effect for reaction of the same substrate with hydroxide ion, $K_H/K_D = 1.09 \pm 0.01$; and the kinetic isotope effect for reaction with tris-(hydroxymethyl)methylamine, $K_H/K_D = 1.10 \pm 0.01$; both of the latter also refer to wholly aqueous solution at 25°C and are for complete deuteration of both methyl groups. It is shown that the equilibrium isotope effect is largely, and the kinetic isotope effects probably partly, hyperconjugative in origin, thus supporting a hyperconjugative explanation of the anomalous effect of methyl groups on nitroalkane ionization. (auth)

20703 ISOTOPE EFFECTS ON CHEMICAL EQUILIBRIA. II. Some Further Secondary Isotope Effects of the Second Kind. Barnes, D. J.; Golding, P. D.; Scott, J. M. W. Can. J. Chem.; 52: No. 10, 1966-1972(15 May 1974).

The ratio of the dissociation constants $K_a(H)/K_a(D)$ has been measured conductimetrically for the isotopic pairs XCH_2COOH/XCD_2COOH where X = Cl, PhO, and PhS. Methods of calculating the ratio of the equilibrium constants are considered in some detail. Since the isotope effect varies with the nature of the X substituent it is concluded that the simple inductive description of these effects is not tenable. (auth)

20704 KINETICS OF ISOTOPE EFFECTS IN A MODEL SOLVOLYSIS SYSTEM INVOLVING ONE OPTICALLY ACTIVE ION PAIR INTERMEDIATE. Vogel, P. C. (Columbia Univ., New York). Can. J. Chem.; 52: No. 10, 1937-1941(15 May 1974).

The derivation of the observed first-order rate constants from the "exact" integrated rate equations is presented. It is shown that the solvolytic exponential first-order rate constant is a special case of the polarimetric rate constant and that the optical activity of the product is determined by a multiplicative ratio of rate constants for the optically important reactions of the ion pair intermediate. A form of the integrated first-order polarimetric rate equation with a linearly independent parameter set is presented. The functions for the first-order rate constants derived using the steady-state approximation are special cases of the functions derived from the exact equations, as are the functions for the first-order rate constants for two systems which involve preequilibria followed by a slow product forming step. These functions cannot all be derived one from the other. A differential analysis of observed isotope effects as functions of isotope effects on the rate constants for reactions involving the intermediates is presented. (auth)

20705 KINETIC AND EQUILIBRIUM STUDIES OF THE REACTIONS OF 2,4,6-TRINITROTOLUENE AND 2,4,6-TRINITROTOLUENE-d_3 WITH SODIUM AND POTASSIUM t-BUTOXIDE IN t-BUTANOL. Buncel, E.; Norris, A. R.; Russell, K. E.; Wilson, H. (Queen's Univ., Kingston, Ont.). Can. J. Chem.; 52: No. 12, 2306-2315(15 Jun 1974).

The reactions of 2,4,6-trinitrotoluene (TNT) and 2,4,6-trinitrotoluene fully deuterated at the methyl position (TNT-d_3) with sodium and potassium t-butoxide in t-butanol have been studied. With TNT as the substrate, proton abstraction by ion-paired sodium or potassium t-butoxide appears to be the predominant reaction in solution. With sodium t-butoxide as base, the forward rate constant for proton abstraction at 30.0°C is 6000 ± 400 M^{-1} s^{-1} while $\Delta H^{\ddagger}$ and $\Delta S^{\ddagger}$ for the reaction are 4.2 ± 0.3 kcal mol^{-1} and -27 ± 2 cal deg^{-1} mol^{-1}, respectively. With TNT-d_3 as the substrate, formation of a TNT-d_3-t-butoxide ion σ-complex occurs simultaneously with deuteron abstraction. Specific rate constants for the two processes have been determined at 30.0°C. Initial studies establish a hydrogen-deuterium kinetic isotope effect of 8 ± 1 for the formation of the anion in t-butanol. (auth)

20706 INVESTIGATION OF THE McFADYEN-STEVENS REACTION. Matin, S. B.; Craig, J. C.; Chan, R. P. K. (Univ. of California, San Francisco). J. Org. Chem.; 39: No. 15, 2285-2289(26 Jul 1974).

The McFadyen-Stevens reaction of 1-benzenesulfonyl-2-benzoylhydrazines to give benzaldehydes has been shown to proceed with first-order kinetics with respect to the anion of the hydrazine. A Hammett plot gave $\rho = -1.38$ and a deuterium isotope effect of $k_H/k_D = 2.28$ at 160° (equivalent to ca. 4.5 at 25°) was obtained. The method provides a convenient and rapid synthesis of 1-deuteriobenzaldehydes. A mechanism is proposed involving a fast reversible α-elimination of sulfinate ion to give an intermediate benzoylaminonitrene, followed by tautomerism of the latter with loss of nitrogen to rearrange to the aldehyde. (auth)

20707 NEW EXPERIMENTAL TESTS OF EXISTING INTERPRETATIONS OF ELECTRONIC TRANSITIONS OF ETHYLENE. Foo, P. D.; Innes, K. K. (State Univ. of New York, Binghamton). J. Chem. Phys.; 60: No. 11, 4582-4589(1 Jun 1974).

The absorption spectra of the gases ethylene-d_0, d_1, 1,1-d_2, cis-d_2, trans-d_2, d_3, and d_4 have been photographed using the first order of a 21-ft vacuum spectrograph. Analyses of both the Rydberg system at 1750 Å and the π^*-π system between 1500 and 2100 Å have been extended. Band contour analysis has confirmed the assignment of the Rydberg system as $^1B_{3u} - {}^1A_g$. The resulting rotational constants of the 4^2 level of the excited state of C_2D_4 lead to an inertial defect indicative of a nonplanar molecule. Assuming point group D_2, we have combined the constants with Franck-Condon calculations in a complete structure determination for the 4^2 level of the Rydstate: $r_{CC} = 1.41$ Å, $r_{CH} = 1.08$ Å, ϕ HCH = 124.4° and an azimuthal angle of 37°. Linewidths in the successful simulation of the C_2D_4 0-0 band indicate a lifetime greater than 10^{-12} sec for molecules in the zero level of the Rydberg state. For the π^*-π system, all observed bands for all molecules studied have been assigned. Most striking is the relative inactivity of the C-C stretching vibration; except in C_2D_4, only the torsional mode is active. It is concluded that r_{CC} for the π^*-π state is not very different than it is for the Rydberg state. Finally, the extrapolation to the (unobserved) origin of the π^*-π system is revised to give 5.5 eV (2285 Å). (auth)

20708 SPECTROSCOPIC STUDIES OF THE SO_2 DISCHARGE SYSTEM. II. Microwave Spectrum of the SO Dimer. Lovas, F. J.; Tiemann, E.; Johnson, D. R. (National Bureau of Standards, Washington, DC). J. Chem. Phys.; 60: No. 12, 5005-5010(15 Jun 1974).

Microwave spectra assignable to a dimer of SO were detected in an electric discharge of SO_2. A centrifugal distortion analysis was carried out on the spectra from the ground state and the lowest excited vibrational state of $^{16}O^{32}S^{32}S^{16}O$ and the ground vibrational state of $^{16}O^{32}S^{34}S^{16}O$. The molecule was found to have a planar cis configuration with the following geometry: r(SO) = 1.458(2) Å, r_s(SS) = 2.0245(6) Å, and $\angle$ SSO = 112.7(5)°. The observed dipole moment of OSSO is $\mu = 3.17(10)$ D. (auth)

20709 ISOTOPE EFFECTS IN THE ESR OF Mn^{++} IN $Ca(OH)_2$ AND $Ca(OD)_2$. Holuj, F.; Kwan, C. T. (Univ. of Windsor, Ont.). Phys. Rev., B; 9: No. 9, 3673-3677(1 May 1974).

Large differences in the values of the spin-Hamiltonian parameter b_2^2 were observed in $Ca(OH)_2$ and $Ca(OD)_2$ at low temperatures, but were not detected in the remaining measured parameters. b_2^2 were analyzed in terms of lattice vibrations. The significance of the remaining parameters is also discussed. (auth)

20710 RADIATIONLESS SINGLET DEACTIVATION IN ISOLATED LARGE MOLECULES. I. Naphthalene, Naphthol, and Naphthylamine. Hsieh J. C.; Huang, C. H.; Lim, E. C. (Wayne State Univ., Detroit). J. Chem. Phys.; 60: No. 11, 4345-4353 (1 Jun 1974).

Fluorescence lifetimes of naphthalene, β-naphthol, and β-naphthylamine were measured under collision-free conditions in the vapor. The lifetimes were then combined with the measured quantum yield (for naphthalene), or with the estimated radiative decay rate (for β-naphthylamine), to deduce the nonradiative decay rate of the molecule as a function of excitation energy. The results indicate that (1) the nonradiative decay probability increases, first slowly then very rapidly, as the ex-

cess vibrational energy in the lowest excited singlet state (S_1) is varied over a range of nearly 20,000 cm^{-1}, and (2) a plot of nonradiative decay rate versus excitation energy exhibits a break at photon energy corresponding to the second excited singlet state of a molecule. Observation (1) is interpreted in terms of two different pathways of radiationless transition that compete in the singlet deactivation of the molecules. It is argued that, in the region of low excess energies, the intersystem crossing to the triplet manifold dominates over the internal conversion to the ground state owing to a more favorable Franck–Condon factor. As the excess vibrational energy is increased the internal conversion, which is expected to display greater energy dependence than the intersystem crossing, becomes increasingly more important and it finally becomes the dominant pathway of nonradiative decay at high excess energies. This model of competing radiationless transitions is shown to be consistent with the observed deuterium isotope effect on the nonradiative decay rate of naphthalene vapor. Observation (2), which confirms our earlier results [J. Chem. Phys. 58, 1247 (1973)], suggests that $S_2 \rightarrow S_1$ internal conversion leads to changes in vibrational distribution, which is substantially maintained during the time scale of radiationless decay of S_1. Thus, the intramolecular vibrational energy redistribution, leading to the randomization of vibrational levels, does not appear to be a fast process even for large molecules with high density of states. (auth)

20711 SPECTROSCOPIC STUDIES OF THE SO_2 DISCHARGE SYSTEM. I. The Microwave Spectrum and Structure of S_2O. Tiemann, E. (Freie Univ., Berlin); Hoeft, J.; Lovas, F. J.; Johnson, D. R. J. Chem. Phys.; 60: No. 12, 5000-5004(15 Jun 1974).

The microwave spectrum of S_2O was reexamined in order to obtain reliable predictions of all rotational transitions up to J = 50 in the frequency region 10–130 GHz and to determine the structure of the molecule. A centrifugal distortion analysis was carried out on the ground state and lowest bending vibrational state of $^{32}S^{32}S^{16}O$. Centrifugal distortion corrected rotational constants have also been obtained for $^{34}S^{32}S^{16}O$ and $^{32}S^{34}S^{16}O$. These observations allowed determination of the structure: $r_s(S-S) = 1.88248(10)$ Å, $r(S-O) = 1.4637(5)$ Å, $\angle SSO = 118.26(7)°$. (auth)

20712 MICROWAVE SPECTRUM OF BF_2OH. Takeo, H. (Governmental Chemical Industrial Research Inst., Tokyo). Tokyo Shikensho Hokoku; 69: No. 3, 73-77(Mar 1974). (In Japanese).

The microwave spectrum of BF_2OH has been observed and assigned. The rotational constants of the isotopic species $^{11}BF_2{}^{16}OH$, $^{10}BF_2{}^{16}OH$, $^{11}BF_2{}^{18}OD$, $^{10}BF_2{}^{18}OD$, $^{11}BF_2{}^{18}OH$ and $^{10}BF_2{}^{18}OH$ have been determined. The inertial defects prove that the molecule is planar. Assuming the two BF bond lengths are the same, the bond distances and angles are found to be: $r_{BF} = 1.32$ Å, $r_{BO} = 1.34$ Å, $r_{OH} = 0.94$ Å, $\angle FBF = 118°$, $\angle BOH = 114.1°$, $\angle FBO = 122.8°$ (this is the angle cis to the OH). The dipole moment is 1.86 ± 0.02 D. The dipole moment makes an angle of 50° with the BO bond with dipole moment line on the same side of the BO bond as the hydrogen. (auth)

20713 EFFECT OF ELECTRON RELEASING GROUPS UPON THE MOLECULAR ORBITALS AND ANION DISPROPORTIONATION EQUILIBRIA OF SUBSTITUTED CYCLOOCTATETRAENES. Stevenson, G. R.; Concepcion, J. G.; Echegoyen, L. (Univ. of Puerto Rico, Rio Piedras). J. Amer. Chem. Soc.; 96: No. 17, 5452-5455(21 Aug 1974).

(Phenyl-d_5)cyclooctatetraene, 1,3,5,7-tetramethylcyclooctatetraene, tert-butoxycyclooctatetraene, and ethylcyclooctatetraene have been reduced to their respective anion radicals and dianions in hexamethylphosphoramide. The thermodynamic enthalpies controlling the disproportionation equilibrium ($\pi^{2-} + \pi \rightleftharpoons 2\pi^{-}$). constant were studied in this solvent. A plot of $\Delta H°$ for this reaction vs. the σ value for the substituent on the cyclooctatetraene ring yields a ρ value of –3.8 kcal/mol. The negative value for ρ indicates that the electron-pushing effect of the substituent concentrates the charge density on the anions and this results in more ion pair formation which in turn increases the enthalpy of the reaction. The ESR spectra of the anion radicals confirm that the electron-releasing substituents remove the degeneracy of the two nonbonding orbitals. The splitting of the nonbonding orbitals is about 0.4 kcal/mol for an alkyl substituent and about 0.78 kcal/mol for an alkoxy group. A plot of this splitting vs. the σ value of the substituent yields a positive ρ value. The disproportionation thermodynamics and the ESR coupling constants for the (phenyl-d_5)cyclooctatetraene anion radical indicate that the angle between the two rings is large. (auth)

20714 OXIDATION OF HYDROCARBONS. IV. Kinetics and Mechanism of the Oxidative Cleavage of Cinnamic Acid by Acidic Permanganate. Lee, D. G.; Brownridge, J. R. (Univ. of Saskatchewan, Regina). J. Amer. Chem. Soc.; 96: No. 17, 5517-5523(21 Aug 1974).

Permanganate ion reacts rapidly with trans-cinnamic acid in aqueous perchloric acid to form an intermediate that subsequently decomposes in a slightly slower reaction to give benzaldehyde and ^{111}Mn. Inverse secondary deuterium kinetic isotope effects ($k_D/k_H = 1.3$), which are obtained for the oxidation of trans-cinnamic acid-α-d and trans-cinnamic acid-β-d, are taken as evidence that the initial reaction involves addition of permanganate ion to the carbon-carbon double bond to form an intermediate hypomanganate ester. Normal secondary deuterium kinetic isotope effects ($k_D/k_H = 1.09$) are observed for the decomposition of the intermediate into products. The first step of the reaction (ester formation) is characterized by a small enthalpy of activation (4.2 kcal/mol) and a large negative entropy of activation (–30 eu), whereas the second step (ester decomposition) exhibits a larger enthalpy of activation (11.9 kcal/mol) and an entropy of activation of similar magnitude (–27 eu). The rate of formation of the intermediate is rather insensitive to the presence of substituents on the aromatic nucleus; however, the rate of decomposition of the intermediate exhibited a Hammett ρ value of –1.1. An attempt was made to propose a unified mechanism that is consistent with all of the known physical data concerning the reaction and which also satisfactorily accounts for the array of products that can be obtained under various conditions. (auth)

20715 AMINOLYSIS OF SUBSTITUTED PHENYL QUINOLINE-8- AND -6-CARBOXYLATES WITH PRIMARY AND SECONDARY AMINES. Involvement of Proton-Slide Catalysis. Bruice, P. Y.; Bruice, T. C. (Univ. of California, Santa Barbara). J. Amer. Chem. Soc.; 96: No. 17, 5533-5542 (21 Aug 1974).

The reaction of primary and secondary amines with a series of substituted (p-CH_3O, H, p-Cl, p-CN, o-NO_2, p-NO_2, and 2,4-diNO_2) phenyl quinoline-8- and -6-carboxylates (Q-8 and Q-6, respectively) has been investigated (20% (v/v) acetonitrile-H_2O, μ = 0.4, 30°). Plots of log k_n vs. σ exhibit a diminution of ρ with increase in σ. This requires a change in rate-limiting step from collapse of the tetrahedral intermediate in the direction of products for the least reactive esters to amine attack for the most reactive esters. The stop-flow recordings obtained for the reaction of methylamine with p-CN-Q-8 evidence the formation of the tetrahedral intermediate; the initial decrease in OD due to addition of amine to ester is followed by an increase in OD as phenoxide ion is expelled from the tetrahedral intermediate. The separation of rate-limiting attack and departure becomes obvious in a plot of log k_n vs. $\Delta pK_a = pK_a$(phenolic leaving group) – pK_a(amine nucleophile)) for the Q-6 esters. The 2,4-diNO_2 substituted esters fall on one line and the less reactive esters on another. A like plot for the Q-8 esters results in three lines: (1) p-CH_3O, H, and p-Cl esters which evidence rate-limiting collapse of the tetrahedral intermediate to products; (2) p-CN, o-NO_2, and p-NO_2 esters with both attack of nucleophile and departure of leaving group partially rate limiting; and (3) 2,4-diNO_2 substituted esters where nucleophilic attack is rate limiting. With the exception of the 2,4-diNO_2 substituted esters, the Q-8 esters are more reactive (by ca. 100-fold) toward primary and secondary amines than are the Q-6 esters. Since breakdown of the tetrahedral intermediate ceases to be rate limiting for the Q-8 esters while it is still rate limiting for the Q-6 esters and dependence of k_n on the leaving group is less for the Q-8 esters (ρ = 1.5–2.5) than for the Q-6 esters (ρ = 2.5–3.4), it follows that the quinoline nitrogen of the Q-8 esters catalyzes collapse of the tetrahedral intermediate to products. The accelerated rate of aminolysis with primary and secondary amines exhibited by the Q-8 esters when departure of the phenoxide leaving group is rate determining is independent of the pK_a of the amine. This conclusion is reached equally by inspection of plots of log k_n vs. ΔpK_a, log k_n^{Q-8} vs. log k_n^{Q-6}, and from the rate ratios k_n^{Q-8}/k_n^{Q-6}. This lack of dependence of catalysis on amine pK_a together with the observation that the weakly basic quinoline nitrogen acts as an efficient catalyst even when the amine moiety of the tetrahedral intermediate is as much as 7.0 pK_a units a stronger base leads to the conclusion that the observed catalysis cannot be due to intramolecular proton transfer from the ammonium group of the zwitterionic tetrahedral intermediate ($T^{\pm}$) to the quinoline nitrogen. Proton-slide catalysis in which the ammonium proton of ($T^{\pm}$) slides across the quinoline nitrogen lone pair orbital to the negatively charged oxygen to yield an uncharged tetrahedral intermediate (T) is suggested. Conversion of $T^{\pm}$ to T results in a crossover from the reaction coordinate for neutral amine attack on neutral ester to anionic amine attack on protonated ester and allows the reaction to proceed through a pathway of lower energy. Intramolecular amine catalysis is observed with esters too reactive to evidence intermolecular catalysis. Intermolecular general base catalysis (by amine) is generally observed when the amine is less than 0.8 pK_a units more basic than the leaving group and is attributed to proton removal from $T^{\pm}$ to give T^{-}

which rapidly collapses to products. Values of k_{-b}/k_a are 2–17 and 20–50 for non-α-effect and α-effect amines, respectively, and are independent of amine or leaving group pK_a. Intramolecular catalysis by α,ω-diaminoalkanes and electrostatic effects in aminolysis reactions are also discussed. The large number of second-order rate constants collected in this study has allowed a critical evaluation of the relationship of the change in one linear free-energy parameter of a reaction series with another. For the reactions investigated herein no useful relationship is apparent between β_{nuc} and σ or between ρ (or β_{lg}) and pK_a. (auth)

20716 ISOTOPE EFFECT IN MICROWAVE CHERENKOV RADIATION. Koch, F. Stud. Univ. Babes-Bolyai, Ser. Phys.; 19: No. 1, 95-96(1974).

The emission angle of Cherenkov radiation in the microwave region can be calculated by use of the refractive index or the permittivity of the medium. As these values are sensitive to the isotopic composition, it can be assumed that in the direction of the irradiated microwave there are differences caused by the isotopic composition of the emitter. (tr-auth)

20717 THERMODYNAMIC ISOTOPE EFFECTS IN ORGANIC COMPOUNDS. I. Carbon Effects in Straight-Chain Alkanes. Galimov, E. M.; Ivlev, A. A. (Moscow Inst. of Petrochemical and Gas Industry). Russ. J. Phys. Chem. (Engl. Transl.); 47: No. 11, 1564-1566(Nov 1973).

Translated from Zh. Fiz. Khim.; 47: No. 11, 2787-2791(Nov 1973).

The β-factors with respect to carbon were calculated in the range from 200 to 700°K for a series of straight-chain alkanes: methane, ethane, propane, butane, and pentane. In systems in a state of isotope exchange equilibrium, an increase of the molecular weight of the alkane entails the enrichment of their carbon in the carbon-13 isotope. The study of the additivity of the β_1-factors in the series of straight-chain alkanes yielded a formula whereby the β_∞-factor for any high-molecular-weight n-alkane can be obtained by extrapolation. (auth)

Isotope Exchange and Isotope Separation

Refer also to abstracts 21148 and 21310.

20718 FRACTIONATION FACTOR FOR L_3O^+ IN H_2O-D_2O. Kresge, A. J.; Albery, W. J. (Illinois Inst. of Tech., Chicago). J. Chem. Soc., Chem. Commun.; No. 13, 507-508(3 Jul 1974).

A recent approach (Batts et al., J. C. S. Faraday I;69:1033 (1973)) based on curve-fitting of solvent isotope curves in H_2O and D_2O mixtures by computer analysis, which leads to a revised value for 1, the fractionation factor for L_3O^+, is shown to be erroneous. (auth)

20719 CARBON-13 NMR: A TOOL FOR STUDYING DEUTERIUM EXCHANGE KINETICS IN COBALT (III) AMINOCARBOXYLATES. Blackmer, G. L.; Vickrey, T. M. (Texas Tech Univ., Lubbock). J. Coord. Chem.; 3: No. 3, 225-233(1974).

Carbon-13 NMR spectral assignments of some cobalt(III) aminocarboxylates are presented. Natural abundance ^{13}C spectra were obtained with a NMR spectrometer equipped with an integration subroutine and a broad band proton decoupler. The kinetics of deuterium substitution on glycinate rings of Co(III)EDTA, Co(III)CyDTA, and Co(III)PDTA were studied. Rate constants obtained here are in good agreement with those obtained in previous PMR studies. Rate constants for some glycinate proton exchanges that were previously unattainable by PMR are also presented. The advantages of using ^{13}C NMR over PMR in these studies are discussed. This study was done at 95°C and pD = 1.5. The rate of isotopic exchange was monitored by the decrease in the proton decoupled integral of the ^{13}C resonances. (auth)

20720 KINETIC STUDIES OF OXYGEN-18 EXCHANGE OF GEOMETRICALLY CONSTRAINED PHOSPHINE OXIDES. Stereomutation at Pentacoordinated Phosphorus. Wetzel, R. B.; Kenyon, G. L. (Univ. of California, Berkeley). J. Amer. Chem. Soc.; 96: No. 16, 5199-5206(7 Aug 1974).

From 166th national meeting of the American Chemical Society; Chicago, IL (26 Aug 1973).

The kinetics of oxygen-18 exchange of a series of phosphine oxides, 1-phosphabicyclo[2.2.1]heptane 1-oxide (1), 1-phosphabicyclo[2.2.2]octane 1-oxide (2), 1-ethyl-2,2,3-trimethylphosphetane 1-oxide (3), 1-ethyl-phospholane 1-oxide (4), 1-ethylphosphorinane 1-oxide (5), and triethylphosphine oxide (6), were measured under a variety of conditions. Exchange presumably proceeds in each case through dihydroxyphosphoranes of trigonalbipyramidal geometry. It was found that pH-rate profiles and Bunnett plots may be used as criteria for distinguishing between exchange mechanisms proceeding via dihydroxyphosphoranes in which both oxo ligands are apical (type I intermediates) and dihydroxyphosphoranes in which the oxo ligands are situated apical–equatorial (type II intermediates). Compounds 4, 5, and 6 were found to exchange by way of type I intermediates and compounds 1 and 3 by type II intermediates. A type I intermediate for phospholane 4 was unexpected, since this requires diequatorial placement of the five-membered ring. Compound 2 underwent exchange much more slowly than the other phosphine oxides, presumably because of the unfavorable electronic effect of forming the type II intermediate, which in this case was not compensated for by relief of ring strain in going into the transition state. Relief of ring strain in 1 and 3 facilitated formation of the type II intermediates. By a simple Berry pseudorotation mechanism the type II intermediate of 1 would not be expected to undergo facile ligand interchange. Since 1 readily underwent exchange, other mechanistic interpretations are considered. (auth)

20721 HOMOGENEOUS CATALYSIS OF HYDROGEN ISOTOPE EXCHANGE BETWEEN D_2 AND ETHANOL BY CHLOROTRIS-(TRIPHENYLPHOSPHINE) RHODIUM(I). II. In Chloroformethanol. Strathdee, G.; Given, R. (Whiteshell Nuclear Research Establishment, Manitoba, Canada). Can. J. Chem.; 52: No. 12, 2226-2235 (15 Jun 1974).

The kinetics and mechanism of D_2 exchange catalyzed by $RhCl(PPh_3)_3$ were studied in chloroform-ethanol solutions. Interpretation of the results was complicated by a side reaction of the solvent to yield HCl, $RhHCl_2(PPh_3)_2$, C_2H_5Cl, CH_2Cl_2, Ph_3PO, and other phosphorus(V) species. Computer simulation of the exchange reaction was used to show that the observed inverse isotope effect $2\kappa_{HD}/\kappa_{D_2} = 0.85$ could arise only if the rate determining step was the activation of D_2, HD and H_2 by $RhCl(PPh_3)_3$. The D_2 exchange reaction rate was extremely dependent on solvent composition and decreased 30 times between 6 and 96 mol% C_2H_5OH. The activation energy for D_2 exchange was 101 ± 9 kJ mol^{-1} at 58 mol% C_2H_5OH, and 86 ± 8 kJ mol^{-1} at 6 mol% C_2H_5OH. These data suggested that solvent-catalyst bonding interactions were important. (auth)

20722 HOMOGENEOUS CATALYSIS OF HYDROGEN ISOTOPE EXCHANGE BETWEEN D_2 AND ETHANOL BY CHLOROTRIS-(TRIPHENYLPHOSPHINE) RHODIUM(I). I. In Benzene Ethanol. Strathdee, G.; Given, R. (Whiteshell Nuclear Research Establishment, Pinawa, Manitoba). Can. J. Chem.; 52: No. 12, 2216-2225 (15 Jun 1974).

The kinetics and mechanism of $D_2-C_2H_5OH$ exchange catalyzed by chlorotris(triphenylphosphine)rhodium(I) have been studied in 50 vol % benzene–ethanol. In this mixed solvent, the rate of exchange was low and was limited by the rate of transfer of deuterium from dideuteridochlorotris(triphenylphosphine) rhodium(III) to the solvent, and not by the rate of activation of D_2. The activation energy for the overall process was relatively low, 35 kJ mol^{-1}. In addition, new data have been presented for the catalysis of H_2-D_2 exchange in benzene by $RhCl(PPh_3)_3$. Analysis of the apparent HD : D_2 isotope effect that is observed during $D_2-C_2-H_5OH$ exchange suggests that this effect originates with the relative stabilities of the D_2, HD, and H_2 adducts with $RhCl(PPh_3)_3$, or by control of the HD and H_2 product distribution by the H_2-D_2 equilibrium reaction. (auth)

20723 PROCESS AND CATALYST FOR ENRICHING A FLUID WITH HYDROGEN ISOTOPES. Stevens, W. H. (to Atomic Energy of Canada Ltd.). Canadian Patent 907,292. 15 Aug 1972.

A process and a catalyst that will exchange hydrogen in liquid water for deuterium from hydrogen gas and which will be immune to poisoning and deactivation by the water are described. The catalyst is composed of a support consisting of at least one of a number of metal oxides, a catalytic surface provided by a metal from Group VIII of the periodic table (preferably Pt, Pd or Ni), and a sealing coating of silicone resin which is permeable to the water vapor and hydrogen gas but impermeable to liquid water. Liquid water and hydrogen gas are passed in countercurrent or co-current flow with each other through the column in contact with the coated catalyst. In a supplementary disclosure polytetrafluoroethylene is claimed as an alternative waterproof coating. (CA)

20724 SEPARATION OF THE ISOTOPES OF POLYISOTOPIC ELEMENTS BY ION ELECTROMIGRATION METHOD IN MOLTEN SALTS. II. Analysis of Some Questions of Steady State Isotope Distribution Along the Separation Tube. Lyubimov, V. N. (Inst. of Inorganic Chemistry, Novosibirsk, USSR). Izv. Sib. Otd. Akad. Nauk SSSR, Ser. Khim. Nauk; No. 7, 5-11(May 1974). (In Russian).

The influence of some factors upon the steady-state isotope distribution of a polycomponent isotopic mixture along the separation tube has been investigated. Electric intensity and effective diffusion coefficient have been shown to determine the achievement rate of the maximum isotope concentration as moving away

from the open end of the separation tube which is connected with an infinite reservoir as well as to determine absolute distances between the maxima of the curves "steady state isotope concentration–coordinate along the tube" but not to affect the absolute value of the maximum coefficients of isotope separation. This value depends merely on the initial isotopic composition of an element and on the position of the isotope in the series of the other isotopes of an element in question. (auth)

20725 ISOTOPIC EXCHANGE OF CHLORINE IN MONOSULFOXIDE COMPLEXES OF PLATINUM(II). Kukushkin, Yu. N.; Kuz'mina, M. A.; Spevak, V. N. Sov. Radiochem. (Engl. Transl.); 15: No. 5, 721-724(1973).

Translated from Radiokhimiya; 15: No. 5, 716-720(1973).

Isotopic exchange of chlorine in the complex ions $[Pt(C_3H_7)_2SOCl_3]^-$, $[Pt\text{-}iso(C_3H_7)_2SOCl_3]$, and $[Pt(CH_2)_4SOCl_3]^-$ was investigated. It was shown that chlorine in the trans position relative to the sulfoxide molecules exchanges practically instantaneously. The rate of the exchange of chlorine in the coordinate Cl–Pt–Cl decreases with an increase in the length and branching of the hydrocarbon radical of the sulfoxide molecule. (auth)

20726 ISOTOPIC EXCHANGE BETWEEN MANGANESE HYDROXIDE AND MANGANESE IONS IN AQUEOUS SOLUTION. El-Atrash, A. M.; Azzam, A. M.; Ghattas, N. K. (Ain Shams Univ., Cairo). J. Radioanal. Chem.; 20: No. 2, 581-587(1974).

Heterogeneous isotopic exchange between manganese hydroxide and manganese ions in aqueous solutions tagged with radioactive ^{54}Mn was studied at different values of α, the ratio of the quantity of exchangeable ions in the solid phase to that in the liquid phase. The aging of the precipitate in its mother liquor prior to the exchange has a significant effect on both the extent and rate of the exchange reaction. A marked feature of great interest is the appearance of two aging-times, one at about 10^2 and the other at about 10^4 min. The overall reaction appears to be of the consecutive type. In the case of a fresh precipitate, "complex-surface exchange" and "self-diffusion" mechanisms are the most probable rate-determining steps in the initial and final stages of the reaction, respectively. "Complex-surface-exchange" is a new suggested mechanism. In the case of a well-aged precipitate, "surface-exchange" and "self-diffusion" mechanisms are the most probable-determining steps in the initial and final stages of the reaction, respectively. (auth)

20727 ABSENCE OF THE EXPECTED FIELD EFFECT IN THE HYDROGEN-ISOTOPE EXCHANGE REACTIONS OF A BRIDGED ANTHRACENE DERIVATIVE CARRYING A NITROGEN POLE. Layton, A. J.; Rees, J. H.; Ridd, J. H. (University Coll., London). J. Chem. Soc., Chem. Commun.; No. 13, 518-519(3 Jul 1974).

In hydrogen-isotope exchange, the overall reactivities of the two aromatic rings of the conjugate acid of 9,10-dihydro-9,10-(trans-11-amino-12-methylethano)-anthracene are the same, in spite of the fact that the nitrogen pole is much nearer one ring than the other. (auth)

Feed Materials Processing

20728 (IAEA-R-1328-F) DEVELOPMENT OF CULTURES OF THIOBACILLUM FERROOXIDANS FOR THE MICROBIOLOGICAL LEACHING OF SULPHIDE AND URANIUM ORES. Part of a Coordinated Programme on the Bacterial Leaching of Uranium Ores. Final Report, 1 December 1972–30 November 1973. Tuovinen, O. H. (International Atomic Energy Agency, Vienna (Austria)). Jan 1974. 4p. INIS.

The development of cultures of Thiobacillus ferrooxidans on inorganic iron and sulfur compounds was investigated to examine in detail the effects and interactions of metal ions on the bacterium with special reference to the development of tolerance to uranium. The enumeration of viable numbers of Thiobacillus ferrooxidans is made by using membrane filters on ferrous iron, thiosulfate or tetrathionate agar. Thiobacillus ferrooxidans was studied in continuous culture in constant pH 1.6, temperature 30°C, dissolved oxygen 20 mm Hg, flow of carbon dioxide into the medium, and controlled flow rates giving dilution rates ranging from 0.02 to >1.0 h^{-1}. The transition of iron-grown organisms to grow on tetrathionate is almost quantitative, whereas few iron-grown organisms are initially capable of growth on thiosulfate. Organisms growing on tetrathionate developed equally well on thiosulfate. Addition of uranyl sulfate to growing cultures causes gradual depression of Fe^{2+}-oxidation, immediate cessation of $^{14}CO_2$-fixation and rapid loss of viability. Maximum growth rate (i.e. D_{crit}) depends on the level of ferrous sulfate in the culture and probably on the Fe^{2+}/Fe^{3+} ratio. High concentrations of ferrous sulfate inhibit ferrous oxidation and may also have uncoupled carbon dioxide fixation. Carbon dioxide fixation is more efficient under conditions of high ferrous iron oxidation rate than under conditions of lower oxidation rate. (INIS)

20729 (LFEN-152(B)) RECOVERY OF URANIUM FROM THE NISA ORE. Study of a High-Grade Sample. Da Silva Santos, C. F. F.; Laxen, P. A. (National Inst. for Metallurgy, Johannesburg (South Africa)). 1973. 32p. Dep. NTIS (U. S. Sales Only) $4.25.

The results of leaching, thickening, solvent extraction, magnetic separation, and radiometric sorting tests, which were conducted on a single ore sample from NISA in Portugal, are presented in this report. Results and observations from mineralogical investigations on rock samples are also included. Four different uranium minerals were identified in these samples. Leaching tests indicated that a small proportion of the total uranium present in this sample of ore was very difficult to leach. Mineralogical examination showed that this uranium that was difficult to leach was attributable to a close uranium-limonite association. Roasting of the ore prior to leaching was found to be effective in breaking up this association between the limonite and the associated uranium and improved extractions were obtained. Unit thickener areas required for the acid leached pulp and the number of thickeners were determined as well as the overall washing efficiency. Solvent extraction tests with solutions of Alamine 336 indicated that an ADU concentrate showing good purity could be obtained. From the testwork that had been conducted, a preliminary flowsheet for the treatment of this ore has been suggested. (auth)

20730 EXPLORATION FOR URANIUM ORES. Part II. Merritt, R. C.; Pings, W. B. (Colorado School of Mines Research Inst., Golden). Colo. Sch. Mines, Miner. Ind. Bull.; 12: No. 6, 1-20(Nov 1969).

Some of the major improvements in processing uranium ores are discussed in detail and include: the application of resin ion exchange and solvent extraction to the concentration and purification of process leach solutions; the development of effective flocculants; and the use of improved techniques for making liquid-solid separations. The use of oxidants during leaching achieved significant improvement in the extraction of uranium and made possible the treatment of a variety of ores with consistently high recovery. Mining, heap, in-situ, and bacterial leaching, ore handling and preparation, and refining operations are also discussed. A 65-item bibliography is provided. (LCL)

Radiation Chemistry

Refer also to abstracts 20783, 20813, 21334, and 21336.

20731 (AEC-tr-7226/10) NUKLEONIKA. Translation of Nukleonika; 17: No. 10, 495-562(1972). 62p. (TT-71-54027/10). Dep. NTIS $6.25.

20732 (AEC-tr-7226/11) NUKLEONIKA. Translation of Nukleonika; 17: No. 11, 563-620(1972). 54p. (TT-71/54027/11). Dep. NTIS $5.75.

20733 (AEC-tr-7422/2) NUKLEONIKA. Translation of Nukleonika; 18: No. 2, 63-104(1973). 40p. (TT-73-54035/2). Dep. NTIS $4.00.

20734 (AERE-R-4987) RADIOLYTIC REACTION BETWEEN GRAPHITE AND CARBON DIOXIDE. Part 5. Gas Flow Experiments in DIDO: Further Experiments on the Effect of Methane. Dominey, D. A.; Morley, H.; Waite, R. J. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Jul 1967. 74p. Dep. NTIS (U. S. Sales Only) $6.75.

Detailed results are given of all experiments with the second and third in-reactor sections of the apparatus. Results reported previously in AERE-R.4817 have been re-examined. The effect of methane on graphite oxidation has been studied at dose rates from 2.2 $W.g.^{-1}$ in a fuel element to about 10 $mW.g.^{-1}$ in the shutdown reactor. The effect of temperature from 375 to 535°C, and pressure from 100 to 300 psig on inhibition by CH_4 were briefly studied. G(–C) in the presence of CH_4 has been calculated by comparison with the value in the presence of a 1% CO/CO_2 mixture. An empirical expression has been derived which relates G(–C) to the concentration of CH_4. The expression embraces almost all the results. In particular, there was good agreement between results obtained with the second in-reactor section which contained a graphite specimen labelled with carbon-14 only on pore surfaces and the results with the third apparatus containing a more uniformly labelled specimen. It is tentatively concluded that the majority of the inhibition of the CO_2-graphite reaction by CH_4 results from the blocking of surface sites by a product of the radiolysis of CH_4 in the presence of CO_2, the more re-

active sites being blocked first. Some active species are probably deactivated by surface complexes which are not destroyed in the process. Some protection is also given by a deposit built up over long periods. CH_4 is destroyed as a result of absorption of energy in CO_2. An empirical equation is derived relating $G(-CH_4)$ to the concentrations of CO and CH_4. (auth)

20735 (CALT-767P4-134) STUDIES IN CHEMICAL DYNAMICS AND RADIATION CHEMISTRY. Technical Progress Report, 1 July 1973–30 June 1974. Kuppermann, A. (California Inst. of Tech., Pasadena (USA)). 30 Jun 1974. Contract AT(04-3)-767. 74p. Dep. NTIS $6.75.

Progress is reported in low-energy scattering, photoelectron spectrometry, elementary reactions by photolysis at variable wave lengths, collisions in crossed molecular beams, and diffusion kinetics in the radiation chemistry of water. Talks and publications are listed. (auth)

20736 (DP-MS-74-4) FISSION FRAGMENT RADIOLYSIS OF 0.4M SULFURIC ACID SOLUTIONS WITH DISSOLVED ^{252}Cf. Bibler, N. E. (Du Pont de Nemours (E.I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). 1974. Contract AT(07-2)-1. 19p. (CONF-740715-5). Dep. NTIS $4.00.

From international radiation research congress meeting; Seattle, Washington, USA (14 Jul 1974).

Radiolysis of 0.4M sulfuric acid solutions at very high LET values (~400 eV/Å) was studied with fission fragments from dissolved ^{252}Cf. This isotope irradiates the solution with both fission fragments and alpha particles. Visible and UV absorption spectroscopy were used to determine $G(Fe^{3+})$ in 10^{-3}M Fe^{2+}, $G(Ce^{3+})$ in 10^{-4}M $Ce^{4+}/10^{-2}$M Ce^{3+}, and $G(Ce^{3+})$ in 10^{-4}M $Ce^{4+}/10^{-3}$M Ce^{3+} containing 10^{-3} or 10^{-2}M Tl^{+}. Values for $G(H_2)$ were determined manometrically. Experiments with alpha particles (LET ≈ 9 eV/Å) from dissolved ^{244}Cm verified the technique and established 100 eV yields (G values) for pure α-radiolysis. Experiments with mixtures of ^{244}Cm and ^{252}Cf established that the effects of fission fragments and alpha particles are independent. The following results were obtained for $G(Fe^{3+})$, $G(Ce^{3+})$, $G(Ce^{3+})$ in 0.001M Tl^{+}, and $G(H_2)$, respectively: for ^{244}Cm–5.1, 2.9, 3.3, 1.3; for ^{252}Cf–4.4, 2.7, 2.9, 1.8; for fission fragments–3.3, 2.4, 2.4, 2.1. Interpretation of the fission fragment yields leads to the following estimates: $G(H_2) = 2.1$, $G(H_2O_2) = 1.0$, $G(HO_2) = 0.5$, $G(OH) = 0$, and $G(H) = 0$. (auth)

20737 (HMI-B-148) PULSE RADIOLYSIS AND POLAROGRAPHY, A REVIEW. Henglein, A. (Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (F. R. Germany)). Jun 1974. 91p. Dep. NTIS (U. S. Sales Only) $7.75.

A critical review and analysis is made of recent studies, primarily at the Hahn-Meitner Institute, on the initiation of polarographic currents in aqueous solutions of various organic and inorganic compounds and in a few organic solvents by a short pulse of 12-MeV electrons is presented. The experimental arrangements at the Institute are described in detail. The kinetics of radical reactions are analyzed. The polarographic waves of radicals are considered theoretically. The polarograms and electrode reactions of various radicals are shown and discussed. The radicals considered are the hydroxyl radical and hydrogen atom, carboxyl radical, $(SCN)_2^-$ and other inorganic radicals, alkyl radicals and radicals from long chain carboxylic acids, alcohol radicals, radicals with conjugated double bonds, α-ether radicals, radicals from the addition of OH to aromatic compounds, radicals from amines and amides, chlorine-containing radicals, and oxyl and peroxyl radicals. (83 references) (JSR)

20738 (IAEA-R-701-F) PRODUCTION OF POLYMER IMPREGNATED FIBROUS MATERIALS FOR WEATHER TESTS IN FAR EASTERN COUNTRIES. Final Report, 1 January 1969–31 December 1971. Autio, T.; Miettinen, J. K. (International Atomic Energy Agency, Vienna (Austria)). Jun 1972. vp. INIS.

Polyester-styrene mixture for surface coating of fiber boards was polymerized by electron beam irradiation. A 400-keV, 3-mA SAMES electron accelerator was used to provide doses of about 15 Mrads for curing operation. The influence of dose rate upon the total dose requirement, the temperature increase during curing, the use of additives and the inhibitive effect of oxygen during polymerization were investigated. The curing characteristics, bonding strength, and flexibility of films were determined with different polyester formulations. Both outdoor and accelerated weather testings were conducted to evaluate the weather resistance of coated fiber boards. After two and a half years outdoor exposure only minor differences were noted between irradiation-cured and peroxide-catalyst-cured boards. Polyester-styrene-acrylamide water emulsions were also tested for anti-shrinking efficiency of impregnated woods. (INIS)

20739 (JAERI-1233) RADIATION-INDUCED POLYMERIZATION OF ETHYLENE IN PRECIPITATING SYSTEM. Wada, T.; Watanabe, T.; Takehisa, M.; Machi, S. (Japan Atomic Energy Research Inst., Tokyo). Mar 1974. 64p. (In Japanese). NTIS (U. S. Sales Only).

Kinetic studies of radiation-induced ethylene polymerization in the presence of tert-butyl alcohol, ethyl alcohol, n-butyl alcohol, cyclohexane, 2,2,4-trimethylpentane, 2,2,5-trimethyl hexane have been made over a temperature range of 3° to 180°C, a pressure range of 60 to 400 kg/cm^2 and a dose rate range of 2×10^4 to 5×10^5 rad/hr. In the part 1 kinetic studies of the polymerization in tert-butyl alcohol at 24°C have led to the following conclusions: (1) G-values of radical formation from ethylene and tert-butyl alcohol are 1.5 and 3.8, respectively; (2) propagation reaction proceeds via monomolecular addition of ethylene; (3) 1st and 2nd order termination of propagating radical take place simultaneously; (4) chain transfer reaction is quite slow. In the part 2 the effects of media and temperature on the polymerization rate, polymer molecular weight and molecular weight distribution have been investigated. On the basis of the kinetic behaviors and the molecular weight distribution, it has been concluded that the polymerization in precipitating media proceeds via radicals in both "loose" and "rigid" physical states. The mobilities of the propagating chains in these states are different from one another and hence the reactivities are different. (auth)

20740 (JAERI-M-5455) TRANSPARENT POLYETHYLENE FILM PRODUCED BY IRRADIATION. Yamaguchi, K.; Machi, S.; Tsukamoto, Y. (Japan Atomic Energy Research Inst., Tokyo). Nov 1973. 34p. (In Japanese). INIS.

The effect of irradiation followed by rolling has been studied to increase transparency of the polyethylene film. The haze value of a commercial high-density polyethylene (Sholex 6009M and 5551H) can be lowered to less than 5% by electron beam irradiation followed by the rolling. The transparency increases with rolling temperature and rolling ratio (thickness before and after rolling). Quenching of the melt after irradiation also increases the transparency. Its highest thermal stability of the transparency is obtained with the gel fraction from 5 to 20%. Wide-angle x-ray diffraction of the irradiated and rolled polyethylene film shows that the orientation of C* axis along a rolling direction increases with rolling ratio. The endothermic peak of its DSC curve is lowered by irradiation and rolling. Its density and melt index are also described. The demands for transparent polyethylene film in Japan may be as high as 1,000 ton/month. Cost of the process is estimated as 28.5 yen/kg (6.8 yen/m^2). (auth)

20741 (JAERI-M-5477) PHYSICAL PROPERTIES OF RADIATION-POLYMERIZED POLYETHYLENE SLURRY. Suwa, T.; Yamaguchi, K.; Watanabe, T.; Kurihara, H.; Wada, T. (Japan Atomic Energy Research Inst., Tokyo). Dec 1973. 44p. (In Japanese). INIS.

Ethylene polymerization by radiation, developed in the JAERI's Takasaki Radiation Chemistry Research Establishment, uses aqueous tert-butanol as the polymerization medium, and the polyethylene is obtained as a slurry. Viscosity of the slurry under the atmospheric and ethylene pressures up to 400 kg/cm^2 was measured for pilot-plant design. The effects of additives on the slurry stability were also measured. Viscosity of the polyethylene-tert-butanol-water slurry increases with concentration of the polyethylene. The apparent viscosities at 30°C are 50 c.p. at 5 g/l PE, 1150 c.p. at 20 g/l PE and 6750 c.p. at 46.6 g/l PE. Viscosity of the polyethylene-tert-butanol-water-ethylene slurry under pressure decreases with increase in the ethylene pressure. At 400 kg/cm^2, the apparent viscosity is several c.p. up to 20 g/l in polyethylene concentration. Addition of water or aqueous solution of a non-ionic surfactant having low HLB value is effective for coagulation of the slurry, and the cationic and nonionic surfactants of higher HL3 than 15 are useful for redispersion of the coagulated slurry. (auth)

20742 (JAERI-M-5500) PRODUCTION OF LOW DIELECTRIC-LOSS POLYETHYLENE BY RADIATION POLYMERIZATION OF ETHYLENE IN 2,2,4-TRIMETHYL PENTANE. Wada, T.; Watanabe, T.; Takehisa, M.; Machi, S. (Japan Atomic Energy Research Inst., Tokyo). Dec 1973. 5p. (In Japanese). INIS.

Polyethylene, produced by radiation-induced heterogeneous polymerization in bulk, is known to have very low dielectric-loss. Continuous process of the bulk polymerization is impossible, however, because the transport of a solid polymer is difficult without a solvent. Among hydrocarbons, 2,2,4-trimethyl pentane is the best solvent to produce of large molecular weight at high rate. Polyethylene has been produced with 2,2,4-trimethyl pentane for its dielectric-loss examination. The molecular weight of polyethylene obtained is 4×10^4. Its IR spectrum shows the methyl content of 11 by 1000 carbons and no adsorption of C=O, C=C, and O–H.

Tan-δ of the polyethylene is 9.2×10^{-5} for 10 MHz at 20°C. The tan-δ for 1 MHz is thus estimated to be about 6×10^{-5}. The value is similar to the lowest dielectric-loss among them of every commercial low-density polyethylene. It is then higher than that of radiation bulk polymerized polyethylene, but lower than that of the polyethylene produced by radiation polymerization in tert-butyl alcohol. (auth)

20743 (JAERI-M-5524) PHYSICAL PROPERTIES OF THE POWDER POLYETHYLENE PRODUCED BY RADIATION-INDUCED POLYMERIZATION (TAKATHENE). Yamaguchi; Kouichi; Takehisa, M. (Japan Atomic Energy Research Inst., Tokyo). Jan 1974. 32p. (In Japanese). NTIS (US Sales Only).

Radiation-polymerized polyethylene "Takathene" is a fine powder with large specific surface area. Its properties were observed in comparison with the conventional powdered polyethylene. The size and shape of Takathene particles vary with polymerization process and its conditions such as temperature and pressure. Takathene produced in the pilot plant of wet-wall for example, is 8–20 μ in particle size, depending on the method of removing solvent from the slurry. Adsorption of hydrocarbon materials onto Takathene is found to be multilayer physical absorption. The uptake by adsorption increases with its specific surface area. The heat of adsorption is about 5–6 kcal/mol at nearly 100% surface coverage. Takathene has large adsorption capacity for nonpolar organic materials, also with good desorption. In a compact bed of powdered Takathene the apparent density is smaller and adhesiveness of the powder layer larger than the conventional polyethylene. Pore sizes of the sintered Takathene powder compact bed are below 0.1 μ. The electrification of Takathene in mechanical friction is high in powder, but nearly the same in molding as the conventional one, possibly due to particle size and shape. (auth)

20744 (JAERI-M-5577) MECHANICAL PROPERTIES OF RADIATION-POLYMERIZED POLYETHYLENE. Sugo, T.; Takehisa, M.; Machi, S. (Japan Atomic Energy Research Inst., Tokyo). Mar 1974. 19p. (In Japanese). NTIS (US Sales Only).

Mechanical properties of the radiation-polymerized polyethylene "Takathene" were examined in relation to its primary properties. (1) Mechanical properties are determined mainly by crystallization (density) and molecular weight (melt index). (2) Mechanical strength is intermediate between that of high-density and low-density polyethylene. (3) There is no appreciable difference in mechanical properties between polyethylenes radiation-polymerized in gas phase and that in the presence of t-butanol in a wet-wall type reactor. (4) Radiation-polymerized polyethylene exhibits peculiar fracture because of the long-chain branch and the small amount of crosslinking structure due to secondary effect of the irradiation. (auth)

20745 (JAERI-M-5593) RADIATION-INDUCED EMULSION COPOLYMERIZATION OF TETRAFLUOROETHYLENE WITH PROPYLENE. Matsuda, O.; Okamoto, J.; Suzuki, N.; Ito, M. (Japan Atomic Energy Research Inst., Tokyo). Mar 1974. 15p. (In Japanese). NTIS (U. S. Sales Only).

Establishing the method of demulsification with high polymer recovery and easy demulsifying operation, without affecting the characteristics of the polymer is important in connection with emulsion polymerization process and its design. Several demulsifying methods, i.e. evaporation, freeze-thaw, mechanical, centrifugal, salt outing, acid or base cracking, and solvent cracking were applied for the latex obtained by radiation-induced emulsion copolymerization of tetrafluoroethylene with propylene using anionic perfluoro emulsifier FC-143. The latex can be demulsified by all but the mechanical. High recovery of the copolymer is obtainable by evaporation, acid cracking, and freeze-thaw methods. The thermostability of the copolymers obtained by evaporation, acid cracking and salt outing method, however, are inferior to those of the copolymers by the other methods. The solvent cracking and the acid or base cracking methods do not require many hours; besides, the operation is easy. The evaporation, acid cracking and freeze-thaw methods are suitable for small quantity of the latex such as in the laboratory and the solvent cracking method is best suited to the commercial scale process. (auth)

20746 (NP-20044, pp 112-113) HEAVY ION RADIOLYSIS OF LIQUID KETONES. Effect of Water on the Radiolysis of Acetone. Matsui, M.; Imamura, M.; Karasawa, T. Dec 1973.

20747 (NP-20044, pp 114-116) ESR STUDIES OF FREE RADICALS PRODUCED IN ORGANIC CRYSTALS IRRADIATED WITH HEAVY IONS. Kimura, K.; Matsui, M.; Karasawa, T.; Imamura, M. Dec 1973.

20748 (RRL-3238-488) QUARTERLY REPORT, APRIL 1, 1974–JUNE 30, 1974. (Mellon Inst., Pittsburgh, Pa. (USA). Radiation Research Labs.). 5 Jul 1974. Contract AT(11-1)-3238. 23p. Dep. NTIS $4.25.

Progress is reported in the following areas: time-resolved ESR studies; dissociation of hydroxyl protons of β-hydroxyalkyl radicals; ESR studies of phenyl radicals; pulse radiolysis studies on electron transfer reactions from surfactant to duroquinone, on Vitamin K in aqueous and micellar solutions, and on folic acid; absorption spectra of some substituted allyl radicals; denitration of nitroimidazoles by OH radicals; behavior of the hydrated electron in positively charged micelles; and radiolysis of nitrobenzene. Abstracts of reports published during the quarter ending June 30, 1974 are included. (LK)

20749 IMMOBILIZATION OF ENZYMES BY RADIOPOLYMERIZATION OF ACRYLAMIDE. Kawashima, K.; Umeda, K. (Ford Research Inst., Tokyo). Biotechnol. Bioeng.; 16: No. 5, 609-621(May 1974).

From annual meeting of the Agricultural Chemical Society of Japan; Tokyo, Japan (Apr 1973).

A method for immobilization of enzymes by the aerobic radiopolymerization of acrylamide was developed. Irradiation treatment of acrylamide in the frozen state produces a spongy immobilized enzyme membrane without the addition of carriers. Aerobic polymerization yields of acrylamide in the frozen state were increased by the addition of starch and also by lyophilization. Glucose oxidase (activity recovery was 12.3 to 33.7%), invertase (69.2%), D-amino acid oxidase (25.0 to 70.5%), aminoacylase (39.2 to 43.7%) mold α-amylase (18.0%), malt β-amylase (4.1%), glucoamylase (6.5%). Alkaline protease (5.3%), and neutral protease (10.5%) were immobilized by this method. Invertase entrapped by this method has a wider optimum pH range and was active at higher temperatures. (auth)

20750 STRUCTURE AND FORMATION OF FREE RADICALS IN IRRADIATED SINGLE CRYSTALS OF NUCLEIC ACID. Mueller, A.; Huettermann, J. (Univ., Regensburg, Ger.). Ann. N. Y. Acad. Sci.; 222: 411-431(31 Dec 1973).

A review is presented of work done since 1967 on irradiated single crystals of nucleic acid constituents; during this period the studies were extended to low temperatures. The general features of radical formation are outlined. The identification of molecular ion radicals in irradiated single crystals is discussed. The studies on the formation of 6-yl and 5-yl radicals in irradiated pyrimidine edrivatives are summarized. Hydrogen abstraction and addition is considered. Radicals on ring nitrogen atoms in pyrimidine derivatives and prine derivatives are described. Hydrogen abstraction from pentose groups is considered separately. The review indicates that in accordance with general principles of radiation chemistry, the predominant processes leading to radical formation in nucleic acid constituents are hydrogen abstraction and addition. (62 references.) (JSR)

20751 RADIATION CROSS-LINKING OLEFIN POLYMERS IN COMBINATION WITH TRIVINYL ISOCYANURATE. Atchison, G. J.; Sundquist, D. J. (to Dow Chemical Company). US Patent 3,817,851. 18 Jun 1974. Filed Date 2 Oct 1972. 8p.

A cross-linked olefin polymer is produced by applying high energy ionizing radiation to a mixture of the olefin polymer and trivinyl isocyanurate in an amount such that the mixture absorbs a radiation dose of between about 0.1 and about 1 megarad. The trivinyl isocyanurate serves to enhance the cross-linkability of the olefin polymer such a high degree of cross-link is achieved with a small radiation dose. The mixture can also contain a foaming agent which can be made to expand and thereby produce a cellular product. Products fashioned of the cross-linked polymer have improved dimensional stability and are more resistant to thermal shrinkage and distortion. The cross-linked olefin polymer can be fashioned into a variety of products having utility in many fields including the packaging and construction industries. (Official Gazette)

20752 EFFECT OF γ RADIATION AND THERMOSHRINKAGE OF POLYETHYLENE FILMS ON THE QUALITY OF IMPRINTED IMAGES. Khozhevets, L. A.; Katishonok, L. A.; Kal'kis, V. Ya. pp 144-147 of Modifikatsiya Svoistv Polimerov. Tarnopol'skii, Yu. M. Riga; Izdatel'stvo Zinatne (1974). (In Russian)

The quality of imprinted images on low density polyethylene films depends on the γ radiation dose from ^{60}Co and the degree of thermal shrinkage of the irradiated samples. Irradiation of the polymer samples in air at doses of 15 to 20 Mrad with subsequent thermal shrinkage up to 25% seems to be the optimum conditions for obtaining stable imprinted images during the typo-offset method of printing on polyethylene. (tr-auth)

20753 ESR STUDY OF BONDING $[NbOF_5]^{3-}$. Rogers, M. T.; Shock, J. R. (Michigan State Univ., East Lansing). pp 101-102

of Proceedings of the XVth International Conference on Coordination Chemistry. Moscow; Izdatel'stvo Nauka (1973).

From 15th international conference on coordination chemistry; Moscow, USSR (25 Jun 1973). See CONF-730638-.

An ESR study has been made of the $[NbOF_5]^{3-}$ ion in γ-irradiated single crystals of $K_2NbOF_5 \cdot H_2O$. The g and A(^{93}Nb), A(^{19}F) nuclear hyperfine tensors have been evaluated from the experimental spectra. The reported values have been corrected for higher order effects by comparing the experimental spectra with those calculated using the computer program MAGNSPEC 3. The results are shown to be consistent with a d^1 configuration for the ion, C_{4v} symmetry, and a $d_{xy}(^2B_2)$ ground state. With certain reasonable assumptions the observed hyperfine splitting tensor for the equatorial fluorines was decomposed into an isotropic term plus two axially symmetric dipolar tensors with axes along, and perpendicular to, the Nb-F bond, respectively. The spin densities in the valence orbitals of these fluorines were then evaluated. (auth)

20754 RADIATION CHEMICAL PROCESSES IN SYSTEMS OF SOLID ORGANIC SUBSTANCES. Bartonicek, B. (Ustav jaderneho vyzkumu, Rez, Czech.). Chem. Listy; 68: No. 6, 580-585(Jun 1974). (In Czech).

A review is given of radiation chemical processes in solid organic substances both at low and at normal temperatures. Attention is given to some interesting difference of processes in solid organic substances when compared with liquid or gaseous system. (auth)

20755 POLYOXYMETHYLENE: RADIATION POLYMERIZATION. Ito, A. (Japan Atomic Energy Research Inst., Takasaki). Kogyo Zairyo; 21: No. 9, 51-54(Sep 1973). (In Japanese).

Review is made on the structure, inherent properties, and use of polyoxymethylene, which is prepared by the solid phase radiation polymerization of trioxane, anhydrous formaldehyde, or tetraoxane. The polymerization products usually consist of fine fibers oriented in a definite direction. The diameter and length of fiber element are 200-300 Å and 1 μ, respectively. The dimensions of the fiber element scarcely change with the change in the condition of polymerization. The tensile strength of polyoxymethylene increases as the cross section of samples decreases by tensile elongation. The tensile strength of commercial polyoxymethylene was 340-360 kg/m^2 when the diameter of the cross section was 2.4 μ, whereas that of the same samples given in catalogue is only 7 kg/mm^2. However, the strength of polyoxymethylene as a solid is not so strong, because it easily cleaves along fiber element boundaries, and fine needles are formed. Impregnation of a certain resin into the mass of polyoxymethylene was very effective for the preparation of mechanically strong mass. By this method, a mass of 50 $kg \cdot cm/cm^2$ in impact strength was obtained. Acetylation of polyoxymethylene is effective to increase the thermal stability of this compound. Stabilized products are widely used for various mechanical and electric parts. (JA)

20756 ESR AND ENDOR STUDIES OF IRRADIATED NUCLEIC ACID CONSTITUENTS. Box, H. C.; Freund, H. G. (Roswell Park Memorial Inst., Buffalo). Ann. N. Y. Acad. Sci.; 222: 446-451 (31 Dec 1973).

ESR and ENDOR studies of barbituric acid and thymidine x-irradiated at 4.2°K are reported. Three of the primary oxidation and reduction products were identified. (LK)

20757 EFFECTS OF METAL IONS ON RADICAL FORMATION IN γ-IRRADIATED DNA IN THE SOLID STATE. Rotlevi, E.; Moss, H. M.; Kominami, S.; Riesz, P. (National Cancer Inst., Bethesda, MD). Ann. N. Y. Acad. Sci.; 222: 387-410(31 Dec 1973).

The effects of metal ions on the formation of radicals produced by γ radiolysis of DNA in vacuo were studied by ESR and hydrogen-transfer measurements. At metal-to-nucleotide ratios of 1:10, a three- to tenfold decrease of the ESR signal due to carbon was observed for transition metals such as Cr^{3+}, Fe^{3+}, Fe^{2+}, Ni^{2+}, and Co^{2+}, and smaller decreases (by 25 to 40%) were seen for paramagnetic rare earths (Eu^{3+}, Yb^{3+}, and Sm^{3+}). These effects were independent of dose and temperature (77 to 298°K). The diamagnetic ions Mg^{2+}, Zn^{2+}, Cd^{2+}, Ag^{+}, La^{3+}, and Lu^{3+} had no effect; however, Ce^{3+}, Pb^{2+}, Sn^{4+} and Hg^{2+} decreased the radical yield by 10 to 60%. At metal-to-nucleotide ratios of 1:100, the radical yield was decreased twofold for Cr^{3+}, Cu^{2+}, and Fe^{3+}, about 30% for Mn^{2+}, Ni^{2+} and Fe^{3+} and <10% for Co^{2+}. From measurements of the power-saturation of the carbon signal for the 1:100 metal-DNA complexes, it can be inferred that the decrease of the ESR signals is not due to spin-spin interactions between carbon radicals and paramagnetic ions. For the 1:10 metal-DNA complexes, spin-spin interactions may contribute to signal reduction. However, these results correlate with measurements of the radiation-induced hydrogen transfer, which can be explained by assuming a decreased radical yield; 1:10 complexes of Ni^{2+} with adenine, polyadenylic acid, dextran, poly-DL-alanine and poly-L-glutamic acid decreased the radical yield by 60-70%, but no effect was observed for thymic and thymidine. It appears that the metal ions act by quenching excited states and/or by charge scavenging. (auth)

20758 ELECTRONIC STRUCTURE OF PHOSPHORANYL RADICALS. Gillbro, T.; Williams, F. (Swedish Research Councils' Lab., Studsvik). J. Amer. Chem. Soc.; 96: No. 16, 5032-5038 (7 Aug 1974). (ORO-2968-85).

Anisotropic ESR studies are reported on the radical anion of phosphorus oxychloride. Single crystals of $POCl_3$ were γ-irradiated at the temperature of liquid nitrogen. Two of the chlorine ligands are magnetically equivalent over a wide range of hyperfine anisotropy and the results are interpreted in terms of a trigonal-bipyramidal (C_s) structure for $POCl_3^-$ with the equivalent chlorines occupying the axial positions. The anisotropic hfs for the axial chlorines corresponds to a spin density of 0.29 in each of the two ligand $3p_\sigma$ orbitals while the isotropic ^{31}P hfs gives a 3s spin density of 0.38 on the central atom. The large spin densities in the $3p_\sigma$ orbitals of the axial chlorines are contrary to the predictions of valence-bond theory but accord well with the results of MO calculations on related radicals. These findings indicate that the unpaired electron in phosphoranyl radicals occupies an MO of a_1 (or a') symmetry whose main component can be represented as a Rundle three-center nonbonding orbital involving the axial ligand orbitals modified by mixing with the symmetry-allowed 3s and 3p orbitals of the phosphorus atom in an antibonding combination. This description also accounts for the previously unexplained observation of large isotropic hyperfine couplings for hydrogen ligands in the axial positions of organophosphoranyl radicals. The effects of ligand electronegativity in both axial and equatorial sites are discussed for a variety of phosphoranyl radicals and it is concluded that the change in the spin density distribution on the phosphorus atom can be explained without recourse to severe distortions from trigonal-bipyramidal geometry. (auth)

20759 EPR SPECTRA OF PARAMAGNETIC CENTERS OF SORBENTS AND ADSORBED RADICALS. pp 407-440 of EhPR Svobodnykh Radikalov v Radiatsionnoj Khimii. Pshezhetakii, S. Ya. Moscow; Khimiya (1972). (In Russian).

Studies were made of the processes of formation of paramagnetic centers in irradiation of different sorbents, formation of adsorbed radicals from molecules adsorbed on the surface, and the interaction of these processes. Heterogeneous radiation processes are described. The EPR method makes it possible to show the interaction of paramagnetic centers of sorbents with adsorbed molecules and to establish the mechanism of transfer of energy in a heterogeneous system, to understand processes occurring between adsorbents and molecules adsorbed on the surface on irradiation. The use of the EPR method for studying adsorbed radicals is based on the fact that non-evaporated electrons of radicals do not form bonds with electrons of the sorbent. The EPR method was used to determine the recombination of radicals and the reaction of active particles with molecules. (tr-INIS)

20760 SEWAGE PROCESSING BY IONIZING RADIATION. Review. Petrenko, L. I. At. Tekh. Rubezhom; No. 7, 19-31 (1973). (In Russian).

Experimental data and technical and economic considerations on the possibility of using ionizing radiation for waste-water processing are presented. Semi-industrial plants designed and constructed in the USA are described. Tests were made to evaluate the costs of the process using radioisotope radiation sources, and technical and economic features in the use of sources of radiation for synthesizing ozone, the most effective oxidant for wash water, are discussed. (tr-INIS)

20761 MODIFICATION OF HALF-WOOLEN CLOTH PROPERTIES BY RADIATION GRAFT OF POLYSTYRENE. Zdol'nikova, G. V.; Vlasov, P. V.; Ryabchikova, G. G.; Glazunov, P. Ya.; Spitsyn, V. I. (Moscow Textile Inst.). Dokl. Akad. Nauk SSSR; 212: No. 3, 679-681(21 Sep 1973). (In Russian).

Half-woolen cloth containing 50% rayon fibers was impregnated with polystyrene and then exposed to 1-MeV electrons to induce radiation grafting with subsequent modification of the durability of the cloth. The dependence of the yield of the impregnated polystyrene on the absorbed dose and the dose rate was determined. It was found that the most durable cloth was obtained from an absorbed dose of 0.43 Mrad, dose rate of 1.91 Mrad/hr, and a temperature of 70°C. (JSR)

20762 ACCELERATED RADIATION POLYMERIZATION OF VINYL-DIVINYL COMONOMER SYSTEMS. Micko, M. M. Vancouver, Canada; University of British Columbia (1973). National Library of Canada, Ottawa.

Thesis (Ph. D.).

Gel-effect acceleration in radiation polymerization of methyl methacrylate–divinyl monomer systems and properties of resulting polymer products have been investigated. Four methacrylate esters with variable molecular bridge length between the double bonds; (i.e., ethylene glycol dimethacrylate, diethylene glycol dimethacrylate, triethylene glycol dimethacrylate, and tetraethylene glycol dimethacrylate) were used as divinyl monomer accelerators and crosslinking agents. All divinyl monomers studied were found to be efficient crosslinking agents and improved the thermomechanical and strength properties of the resulting copolymers. The compression stress, strain and toughness exhibited well defined maxima within 5 - 10% of divinyl monomer in the mixture. Within this concentration interval both maximal acceleration and superior mechanical properties of copolymers were obtained. The numerical value of copolymer connection number (CN_{cp}) was found to be a useful structural parameter relating mechanical and thermomechanical properties with copolymer crosslinking density. (LK)

20763 RADIOISOMERIZATION AND PHOTOISOMERIZATION OF LIQUID 2-BUTENES IN THE PRESENCE OF SULFUR COMPOUNDS. Collin, G. J.; Perrin, P. M.; Garneau, F. X. (Quebec Univ., Chicoutimi, Can.). Can. J. Chem.; 52: No. 12, 2337-2340 (15 Jun 1974).

The liquid phase radiolysis and photolysis of cis- and trans-2-butenes were studied in the presence of various additives. A very efficient isomerization of 2-butenes was achieved by the addition of thiols of low molecular weight (hydrogen sulfide, methyl and isopropyl mercaptans). In the absence of molecular oxygen, G values (trans-2-butene) of the order of 90,000 were observed. On the other hand, little or no isomerization occurred in the presence of carbon disulfide, sulfur hexafluoride, and tert-dodecylmercaptan. Although the majority of the additives have no effect on the 2-butene:hydrogen sulfide system, conjugated diolefins block the isomerization reaction. These diolefins disappear from the reaction mixture. (auth)

20764 PRODUCTION OF GRAFT POLYMERS OF COPOLYMERS BY THE USE OF ACID AND RADIATION. Garnett, J. L.; Dilli, S. (to Unisearch Ltd.). Canadian Patent 943,491. 12 Mar 1974.

A process is described for the production of graft polymers or copolymers by ionizing radiation in the presence of mineral acid. Cellulose is irradiated in the presence of mineral acid and a solution of styrene in a solvent selected from a specified group capable of swelling the cellulose to enable the styrene to gain access to active sites on the cellulose. Irradiation is carried out at a dose rate and with concentrations of styrene in the solvent and mineral acid which together produce a maximum amount of grafting for a given dose rate. (CA)

20765 DEGRADATION OF REED AND ITS CHEMICAL COMPONENTS UNDER THE INFLUENCE OF THE RADIATIONS. Bozmarin, G.; Butnaru, R. Cellul. Chem. Technol.; 6: No. 4, 393-404(1972). (In German).

Splinters of Arundo donax and Phragmites communis reed were subjected to the action of γ radiations from ^{60}Co to doses between 1 and 300 mrad. The cellulose/lignin ratio remained constant but chemical modifications took place in a series of carbon hydrates easily hydrolysable and an important modification of the extractive substances proportion. The hydrolysate analysis by chromatography on paper evinced the chemical and structural modifications which occur in the radiochemical conversion process of hexoses to pentoses. (Rom. Sci. Abstr.)

20766 RADIATION-SENSITIZED THERMAL CRACKING OF N-BUTANE. I. Radical Reactions. Matsuoka, S. (Furukawa Electric Co., Ltd.; Tokyo); Tamura, T.; Oshima, Y. Can. J. Chem.; 52: No. 14, 2579-2589(15 Jun 1974).

The radiolysis of n-butane was investigated at temperatures ranging from 17 to 548°C in both static and flow systems. It was concluded that in the radiation-sensitized thermal cracking region the main products, methane, ethane, ethylene, and propylene, were formed by a radical chain mechanism. The conclusion was reached from comparison with the thermal cracking products, the effect of ammonia addition, the dose rate dependence, and in particular the correlation between the temperature change of the type of the main chain-termination reaction and that of the activation energy of propylene formation. The value of the activation energy for propylene formation showed that the main chain-termination reaction at temperatures between 410 and 520°C was a combination reaction of ethyl radicals. The major part of 1-butene, trans-2-butene, and cis-2-butene formed in the chain region, was shown to result from the thermal decomposition of the chain carrying butyl radicals. Rate parameters for some of the reactions involved were calculated. (auth)

20767 REACTIONS OF THE IONS ISO-$C_4H_9^+$ AND T-$C_4H_9^+$ WITH ISOBUTENE IN THE LIQUID AND GASEOUS PHASES. Collin, G. J. (Quebec Univ., Chicoutimi, Can.). Can. J. Chem.; 52: No. 12, 2341-2347(15 Jun 1974).

The radiolysis of neopentane has been studied in gas and liquid phases. It was shown that, in the liquid phase, the iso-$C_4H_9^+$ ion reacts at least as quickly with isobutene as with methylcyclopentane. The t-$C_4H_9^+$ ion reacts at least 10 times more rapidly with isobutene and the main reaction is one of resonant transfer of a proton with isobutene fewer than 5% of the t-$C_4H_9^+$ ions add to isobutene. In the gas phase, the condensation reaction is more important than that of resonant proton transfer since proton transfer represents only 30% of the total reaction: κ(addition)/κ(transfer) $\simeq 2.35 \pm 0.15$. Finally, the resonant transfer of a deuteron occurs about 2.9 more slowly than proton transfer. (auth)

20768 PULSE RADIOLYSIS OF LIQUIDS AT HIGH PRESSURES. V. Absorption Spectrum and Yield of the Solvated Electron in Liquid Ammonia at 23°C and Pressures up to 6.7 kbar. Farhataziz; Perkey, L. M.; Hentz, R. R. (Univ. of Notre Dame, IN). J. Chem. Phys.; 60: No. 11, 4383-4389(1 Jun 1974).

The absorption spectrum and primary yield of the solvated electron in liquid ammonia (e^-_{am}) were determined by nanosecond pulse radiolysis of liquid ammonia at 23°C and pressures up to 6.7 kbar. With increase in pressure from 0.009 kbar (vapor pressure at 23°C) to 6.7 kbar, the following changes occur in the absorption spectrum: The transition energy at the absorption maximum (E_{max}) increases from 0.67 to 0.91 eV; the observable portion W of the bandwidth at half-maximum, from E_{max} to the high-energy side of the spectrum, increases by 35%; and optical density at the absorption maximum (OD_{max}) decreases by 32%. The pressure and temperature dependences of E_{max} are attributed to changes in (1) size of the electron cavity and (2) the local dielectric constant associated with the solvation shell of the electron. At 23°C and 0 kbar, $(\partial \ln E_{max}/\partial P)_T$ for e^-_{am} exceeds that for solvated electrons in water, methanol, and ethanol by a factor of ~4. Such a result indicates that the cavity of e^-_{am}($\bar{V}$ = 98 ml mol^{-1}) is more compressible than that of the electron in water ($\bar{V}$ = 7 ml mol^{-1} for e^-_{aq}) and the alcohols. From the changes in W and OD_{max} with increase in pressure from 0.009 to 6.7 kbar, the extinction coefficient at the absorption maximum is estimated to decrease by 19% (similar to the result for e^-_{aq}) and the primary yield is estimated to decrease from 3.2 to 2.0 solvated electrons per 100 eV (in contrast with invariance of the e^-_{aq} yield). The decrease in primary yield is attributed to an increase in the probability of neutralization relative to separation of geminate $NH_4^+ - e^-_{am}$ pairs owing to the large negative activation volume of the neutralization reaction as a consequence of the large volume of e^-_{am}. (auth)

20769 EFFECT OF GAMMA-RAY IRRADIATION ON THE SORPTIVE PROPERTIES OF HYDROUS SiO_2 AND ZrO_2. Kar, K. R.; Srivastava, P. K. (Univ. of Delhi). J. Radioanal. Chem.; 20: No. 2, 575-579(1974).

The sorption capacities of hydrous SiO_2 and ZrO_2 for the Zn(ammine) ion were observed to increase on irradiation with γ rays, by ca. 4.1 and 3.8%, respectively. The rates of sorption increased differently in the irradiated exchangers, depending on their characteristic natures; e.g., when the external concentration of the Zn(ammine) solution is 0.2M, the increase in the F value due to irradiation is more striking in the case of SiO_2 than for ZrO_2. On the other hand, at a lower external concentration of the Zn(ammine) solution (0.01M), the increase in the F value, particularly during the first five minutes, is more significant for ZrO_2. (auth)

20770 EFFECT OF DOSE AND γ-IRRADIATION RATE ON THE EDGE OF THE FUNDAMENTAL ABSORPTION BAND OF TRIGLYCINE SULFATE. Sirota, N. N.; Korina, R. V. Zh. Prikl. Spektrosk.; 20: No. 3, 466-469(Mar 1974). (In Russian).

The change in the spectral characteristic of γ-irradiated monocrystals of triglycine sulfate with an increase in radiation dose from 9×10^2 to 3.2×10^7 R was studied. The rate from the γ source changed from 40 to 1600 R/sec. The chief factor determining the displacement of the edge of the absorption band and decrease in width of the forbidden zone is the γ dose. Defects induced in the crystal are stable to both long isothermal holding at 20°C and to high-temperature annealing. (tr-auth)

20771 PULSE RADIOLYTIC DECOMPOSITION OF p-NITROPEROXYBENZOIC ACID. Lilie, J.; Heckel, E.; Lamb, R. C. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). J. Amer. Chem. Soc.; 96: No. 17, 5543-5547(21 Aug 1974).

p-Nitroperoxybenzoic acid (I) is reduced by e^-_{aq} with $k_1 = 1.5 \times 10^{10}$ M^{-1} sec^{-1} and by 2-hydroxy-2-propyl radicals (derived from isopropyl alcohol) with $k_4 = 3.3 \times 10^9$ M^{-1} sec^{-1}. The resulting

radical anion (II) eliminates an ·O–H radical with $k_3 = 2.1 \times 10^3$ sec^{-1} and forms the p-nitrobenzoate anion. The pK_a of the conjugate acid of radical anion II is 2 or below and that of radical anion II itself is 8.25. When isopropyl alcohol is present, a chain reaction occurs, which is apparently caused by 2-hydroxy-2-propyl free radicals that arise from the interaction of ·OH with the alcohol. (auth)

20772 DIRECT OBSERVATION OF THE OPTICAL ABSORPTION SPECTRA OF REACTIVE FREE RADICALS AT ROOM TEMPERATURE. Jordan, J. E. (Univ. of Pittsburgh); Pratt, D. W.; Wood, D. E. J. Amer. Chem. Soc.; 96: No. 17, 5588-5590(21 Aug 1974).

Development of a method for obtaining the optical absorption and emission spectra of free radicals, which not only overcomes the disadvantages of previous techniques but also permits the observation of their spectra at relatively high temperatures and under steady-state conditions is reported. The new method makes use of the fact that high concentrations of free radicals can be produced by x-ray and/or uv irradiation of suitable precursors in an adamantane matrix. (LK)

20773 ADVANCES IN RADIATION CHEMISTRY. Volume 4. Burton, M.; Magee, J. L. (eds.). New York; John Wiley and Sons, Inc. (1974). 418p. $31.50.

Four reviews concerning different aspects of the motion and final state of the electron released in ionization processes are presented. Ionization in nonpolar molecular liquids, excess-electron processes in disordered materials, trapped electrons in organic glasses, and radiation chemistry of polyethylene are the topics of the present volume. Individual abstracts were prepared for each paper. (JSR)

For abstracts of individual papers see: 20774–20777.

20774 IONIZATION IN NONPOLAR MOLECULAR LIQUIDS BY HIGH-ENERGY ELECTRONS. Hummel, A. (Interuniversitair Reactor Instituut, Delft, Netherlands). Advan. Radiat. Chem.; 4: 1-102(1974).

Some basic theory regarding the behavior of charged particles while experiencing Brownian motion in their mutual Coulomb field is summarized. The experimental results from electric conductance measurements on escaped ion yields, as well as on mobilities, in a few liquids are briefly reviewed. The relation of the yield of escaped ions to the initial spatial distribution of the ions is also discussed. Information on the ionization processes in liquids can be obtained from the study of chemical changes resulting from energy deposition by fast electrons. These are discussed in the final section on chemical reactions of ions. (92 references) (JSR)

20775 EXCESS-ELECTRON PROCESSES IN RADIATION CHEMISTRY OF DISORDERED MATERIALS. Funabashi, K. (Univ. of Notre Dame, IN). Advan. Radiat. Chem.; 4: 103-180 (1974).

The concepts of localized and extended states are briefly reviewed and their implications are discussed. Mechanisms of electron trapping are considered. The optical absorption spectra of the trapped electrons are described. Basic theories relevant to understanding the experimental results are reviewed, specifically attenuation of the electron wave and transport mechanisms. Electrons in Coulomb potentials are considered from three aspects: ionization in a condensed phase, optical response of a trapped electron in a Coulomb field, and diffusion kinetics of thermalized electrons. An attempt is made to offer a theoretical interpretation of recent experimental work. (73 references) (JSR)

20776 TRAPPED ELECTRONS IN ORGANIC GLASSES. Kevan, L. (Wayne State Univ., Detroit). Advan. Radiat. Chem.; 4: 181-305(1974).

The characteristics of trapped electrons in organic glasses are examined. The physical characteristics of glassy matrices that trap electrons are discussed. The trapping on solvation process and the trapped-electron yields observed are described. The experimental data on the energy-level structure of trapped electrons from the ground state up to the conduction state are summarized. The mobility of photoexcited electrons and the nature of the conduction state are discussed. Past and current theoretical models for the energy-level structure of trapped electrons are described. 273 references. (JSR)

20777 RADIATION CHEMISTRY OF POLYETHYLENE. Dole, M. (Baylor Univ., Waco, TX). Advan. Radiat. Chem.; 4: 307-388(1974).

An extensive review is presented of recent results in the radiation chemistry of polyethylene. After a brief discussion of the role of polymers in the area of radiation chemistry and the nature of polyethylene, the experimental techniques used in the study of its radiation chemistry are described. The current theory of radiation effects in polyethylene is explained with reference to hydrogen evolution, double-bond formation, cross-linking, free-radical migration, and radiation-induced reactions of double bonds. Experimental results are discussed and compared with theory. 160 references. (JSR)

20778 GRAFT COPOLYMERS BY SIMULTANEOUS ^{60}Co IRRADIATION OF STARCH, ACRYLAMIDE, AND N,N,N-TRIMETHYLAMINOETHYL METHACRYLATE METHYL SULFATE. Fanta, G. F.; Burr, R. C.; Doane, W. M.; Russell, C. R. (Dept. of Agriculture, Peoria, IL). J. Appl. Polym. Sci.; 18: No. 7, 2205-2209(Jul 1974).

Previously, we have studied the graft polymerization of mixtures of acrylamide and N,N,N-trimethylaminoethyl methacrylate methyl sulfate (TMAEMA · MS)

$$CH_2=C(CH_3)CO_2CH_2CH_2N^+(CH_3)_3\ OSO_3CH_3^-$$

TMAEMA · MS

onto starch that had been preirradiated with cobalt 60. Since starch-graft copolymers of this type function as flocculants and also as retention aids in papermaking, we are currently seeking to optimize methods for their synthesis. We now report the simultaneous irradiation of starch and mixtures of the two monomers, a method which, for these graft copolymers, offers definite advantages over initiation by preirradiated starch. Although the simultaneous ^{60}Co-irradiation of polysaccharide-monomer mixtures is a well-known procedure for graft polymerization, a study of our particular monomer system has not been previously reported. (auth)

20779 THERMAL STABILITY OF RADIATION-GRAFTED POLY(VINYL CHLORIDES). Yamakawa, S.; Stannett, V. (North Carolina State Univ., Raleigh). J. Appl. Polym. Sci.; 18: No. 7, 2177-2193(Jul 1974).

The thermal stability of radiation-grafted poly(vinyl chloride) (PVC) has been investigated by thermogravimetric analysis and compared with the thermal stability of the corresponding PVC polymer blends. Although both the grafting of methyl methacrylate and styrene and the blending of the corresponding homopolymers yield products of improved thermal stability as compared with unmodified PVC, the radiation grafting is somewhat more efficient for the stabilization of PVC than blending. Further, the rate of dehydrochlorination of PVC-g-styrene at relatively high temperatures exhibits a retardation, whereas that of unirradiated PVC show significant acceleration. A detailed study about a series of PVC-g-styrenes polymerized under various conditions shows that the retardation effect is more noticeable in the samples irradiated to 2.0–3.0 Mrad than in those irradiated to less than 1.0 Mrad. From the dose dependency, it has been suggested that the retardation effect is due to the interruption of the propagation of dehydrochlorination by branch sites produced by the radiation process. On the other hand, the graft copolymers of vinyl pyridines, PVC-poly(vinyl pyridine), and PVC irradiated in the presence of pyridine are much less stable than unmodified PVC. The instability is explained in terms of the substitution reaction with the bases and the base-catalyzed dehydrochlorination of PVC. (auth)

Radiochemistry and Nuclear Chemistry

Refer also to abstract 21996.

20780 (ZfK-251) PREPARATION OF TRITIUM LABELLED ORGANIC COMPOUNDS BY THE WILZBACH METHOD. Roemer, J. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). May 1973. 20p. (In German). Dep. NTIS (US Sales Only) $4.00.

A survey is given on the methods used to prepare tritium labelled compounds. Among these methods the Wilzbach procedure is considered intensively. Advantages and disadvantages are discussed. For customers the report is intended to show the possibilities and limits of the Wilzbach procedure. (auth)

Hot-Atom Chemistry

20781 (AED-Conf-73-402-017) HOW FREQUENTLY DO ISOTOPE EFFECTS OCCUR IN RECOIL CHEMISTRY? The Chemical Behaviour of Eight Rhenium Isotopes in Neutron and Proton-Irradiation Rhenium Carbonyl $Re_2(Co)_{10}$. Henrich, E.;

Wolf, G. K.; Ianovici, E.; Milman, M. (Heidelberg Univ. (F. R. Germany). Fachgruppe Physikalische Chemie). 1973. 9p. INIS.

From 7th international hot atom chemistry symposium; Juelich, F. R. Germany (10 Sep 1973).

4 figs.; 20 refs. With abstract.

Two kinds of nuclear reactions, 25 MeV neutron-induced and 600 MeV proton-induced, in dirhenium decacarbonyl were studied for the production of eight radioactive rhenium isotopes. The chemical behavior of the Re recoil atoms was followed by measuring their retentions. Here, the retention of a Re isotope is defined as that part that sublimes in vacuum together with the matrix. The identification of the different isotopes as well as their quantitative evaluation was performed by means of γ spectroscopy. The aim of the experiments was to show in what way nuclear properties are able to modify the recoil-chemical behavior. The results support the conclusion that the large isotope effects found in both nuclear reactions are due to the fact that the stopped recoil atoms still "remember" the nuclear reaction. The γ cascade of the excited recoil nuclei may not be terminated after thermalization and the probability of still finding them in an excited state depends on the properties of the nuclear levels and the type of nuclear reaction. Recoil and conversion of the delayed γ quanta then cause a reorientation of the previously formed chemical species. Thus, the final chemical fate of a recoil atom is decided by a one, two, or possibly a many-step process. Some tentative experiments have given results, which suggest that isotope effects are the rule rather than the exception in recoil chemistry. (GE)

20782 REACTIONS OF RECOIL TRITIUM ATOMS IN LIQUID MIXTURES OF ISOOCTANE AND BENZENE. Avdonina, E. N. Sov. Radiochem. (Engl. Transl.); 15: No. 5, 725-729(1973).

Translated from Radiokhimiya; 15: No. 5, 720-726(1973).

Organic mixtures containing lithium carbonate powder in sealed quartz ampoules were irradiated with a thermal neutron flux of 1.2×10^{13} neutrons/cm^2 · sec at 70°C for 10 min. The values given for the radiochemical yields are the ratios of the activities of the corresponding hydrocarbons to the total activity of all the gaseous, liquid, and polymeric products formed by recoil tritium atoms in the systems investigated. The accuracy of the determination of the light labeled products was ±5-10% and of the high-boiling and polymeric fractions, ±10-15% (5% significance level). (LK)

Properties of Radioactive Materials

Refer also to abstracts 20673, 21093, 21123, 21421, 21495, and 21497.

20783 (AEC-tr-7422/3) NUKLEONIKA. Translation of Nukleonika; 18: No. 3, 105-158(1973). 48p. (TT-73-54035/3). Dep. NTIS $4.00.

20784 (BNWL-SA-4830) SOLID PLUTONIUM NITRATE SHIPPING FORMS. Bryan, G. H.; Ryan, J. L. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1974. 10p. (CONF-740901-2). Dep. NTIS $4.00.

From fourth international symposium on packaging and transportation of radioactive materials; Miami Beach, Florida, USA (22 Sep 1974).

A solid plutonium shipping form that is easily prepared, reasonably stable, and which may be dissolved directly in nitric acid would be most desirable. Plutonium compounds that may meet these criteria are $Pu(NO_3)_4 \cdot XH_2O$, $K_2Pu(NO_3)_6$ and $(NH_4)_2Pu(NO_3)_6$. All of these compounds have been prepared with weapons grade plutonium with the simple nitrate ($Pu(NO_3)_4 \cdot XH_2O$) having also been prepared with ^{238}Pu (85%) to accelerate radiolytic degradation studies. Solubility of the compounds in nitric acid solutions is satisfactory after radiation damage corresponding to aging of the reactor grade Pu compounds of at least five years for the $Pu(NO_3)_4 \cdot XH_2O$ and to at least two months for $K_2Pu(NO_3)_6$ and $(NH_4)_2Pu(NO_3)_6$. Oxygen is the primary radiolytic gas produced from $^{238}Pu(NO_3)_4 \cdot XH_2O$ with minor amounts of other gases including very small amounts of hydrogen. G values have been calculated for each of the identified gases. (auth)

20785 (COO-1170-197) AEC CHEMICAL THERMODYNAMICS. Final Report. Westrum, E. F. Jr. (Michigan Univ., Ann Arbor (USA). Dept. of Chemistry). 30 Dec 1973. Contract AT(11-1)-1149. 81p. Dep. NTIS $7.25.

Heat capacity measurements are underway on uranium pnictides, including antimonides, arsenides, and bismuthides. Studies are also being made on lanthanide hexaborides, tribromides, and trichlorides. The thermophysical properties of molecular crystals of azulene, acenaphthene, and acenaphthylene were studied. Studies on the enthalpies of combustion of selected molecular crystals are reported. Heat capacity studies on various inorganic substances, including ferrous tungstates and molybdates, zinc tungstate, ferrospinels, magnetite, and molybdenum compounds, are also reported. A list of papers already published, in press, and submitted for publication is included. (JGB)

20786 (JINR-P12-7758) CHEMICAL EFFECTS CONNECTED WITH VARIOUS PROCESSES OF RADIOACTIVE DECAY OF Ce ISOTOPES IN COMPLEXES WITH POLYAMINE-POLYCARBOXYLATE CHELATE LIGANDS. Beyer, G. U.; Herrmann, E.; Khalkin, V. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1974. 30p. (In Russian). Dep. NTIS (US Sales Only) $4.50.

In the decay of Ce isotopes in the polyaminepolycarboxylate complexes the electron capture and converted γ-transitions lead practically to 100% transition of the daughter atoms into the ion form. The initial molecule decay does not depend on the ligand nature. The electron shaking effect, accompanying the β-decay, releases 19% of the daughter atoms. This process does not depend on the ligand nature also. The daughter atoms with n = 4+ are reduced up to 3+ state duction process and remain connected with the ligands produced in the oxidation. These ions can pass into the free form due to the exchange processes in the solution. (auth)

20787 (LA-UR-74-954) HYDROUS OXIDE COMPOSITIONS OF RARE EARTH (III) CATIONS AND MIXED VALENCE CHROMIUM (III), (V), (VI). Onstott, E. I.; Heaton, R. C. (Los Alamos Scientific Lab., N. Mex. (USA)). 1974. Contract W-7405-eng-36. 6p. (CONF-741002-7). Dep. NTIS $4.00.

From 11th rare earth research conference; Traverse City, Michigan, USA (7 Oct 1974).

Hydrous oxide compositions containing rare earth (III) cations and chromium (III), (V), and (VI) were prepared by reaction of chromate (VI) with a deficiency of reducing agent under hydrolysis conditions at ~293°K. Valence states were identified by absorption spectra, oxidizing titer, RE/Cr ratios, and thermogravimetric measurements. $EuCrO_4 \cdot 0.08\ EuCr_2O_7 \cdot 0.55\ CrCrO_4 \cdot 7.5\ H_2O$ was prepared by reaction of $EuCl_2$ with K_2CrO_4 plus $K_2Cr_2O_7$ at pH 5.1. $EuCrO_4 \cdot 2.02\ EuCr_2O_7 \cdot 0.70\ CrCrO_4 \cdot 4.6\ H_2O$ was prepared by reaction of $EuCl_3$ and KI with K_2CrO_4 plus $K_2Cr_2O_7$ at pH 5.1. $GdCrO_4 \cdot 0.09\ CrCrO_4 \cdot 0.04\ Cr(OH)_3 \cdot 6.9\ H_2O$ was prepared by anodic oxidation of Gd metal in the presence of $K_2Cr_2O_7$ at hydrogen ion concentrations resulting from hydrolysis and electrolysis. Hydrous oxide precipitates were gelatinous, dark brown in color, and difficult to filter. Some hydrolysis took place on washing with water. Air-dried and freeze-dried samples gave no x-ray pattern. Thermogravimetric measurements indicated thermal stability in air to >650°K but <950°K, as shown by weight loss with corresponding change in color from dark brown to almost black to light green. (auth)

20788 (MLM-2153) PLUTONIUM-238 DIOXIDE DISSOLUTION STUDY. Etter, D. E.; Herald, W. R. (Mound Lab., Miamisburg, Ohio (USA)). 31 Jul 1974. Contract AT-33-1-GEN-53. 8p. Dep. NTIS $4.00.

The effects of calcination temperature, HF concentration, HNO_3 concentration, and HNO_3 volume on the dissolution of oxalate-precipitated $^{238}PuO_2$ were investigated. A calcination temperature of 500°C is recommended because of the assurance of complete decomposition of the oxalate and subsequently a reasonable dissolution rate. The study shows that if the HF-to-PuO_2 ratio is maintained at 10 mg/g, the volume of concentrated HNO_3 can be varied from 2 to 7 ml/g of PuO_2 without affecting dissolution. In this case, the HF molarity varied from 0.071 to 0.25 molar. Complete dissolution can be achieved in 8 hr at 30°C, when the HF-to-PuO_2 ratio is increased to 15 mg/g. (auth)

20789 (UCRL-75696) TWO-STEP SELECTIVE PHOTOIONIZATION OF ^{235}U IN URANIUM VAPOR. Tuccio, S. A.; Dubrin, J. W.; Peterson, O. G.; Snavely, B. B. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 12 Jun 1974. 12p. (CONF-740617-6). Dep. NTIS $4.00.

From 8th international quantum electronics conference; San Francisco, California, USA (10 Jun 1974).

Selective photoionization of ^{235}U was demonstrated in a beam of uranium vapor using a tunable CW dye laser and a Hg-arc lamp. The ions thus generated were then separated from the atomic beam by means of electrostatic deflection. The apparatus in this experiment was set-up primarily to evaluate various parameters associated with two-step processes in uranium vapor; such as photoionization cross sections and excited state lifetimes. No effort was made to make this sytem efficient for producing macroscopic quantities of ^{235}U. Scaling of this particular system for a commercial process would be very difficult at best. However, it is possible to conceive of a variety of separation processes based upon atomic vapor. This experiment was performed as a logical first step in the evaluation of this class of processes. (auth)

20790 PROCEEDINGS OF THE XVth INTERNATIONAL CONFERENCE ON COORDINATION CHEMISTRY, MOSCOW, USSR, JUNE 25–30, 1973. Sections I thru VI. Moscow; Izdatel'stvo Nauka (1973). 722p. (CONF-730638-).

One hundred twenty-five papers were presented at the conference; twelve of these papers were referenced and indexed separately. (LK)

For abstracts of individual papers see: 20701, 20753, and 20791–20800.

20791 STEREOCHEMISTRY OF COMPLEX FLUOROURANYLATES. Mikhailov, Yu. N.; Udovenko, A. A.; Kuznetsov, V. G.; Kurnakov, N. S. (Inst. of General and Inorganic Chemistry, Moscow). pp 45–46 of Proceedings of the XVth International Conference on Coordination Chemistry. Moscow; Izdatel'stvo Nauka (1973).

From 15th international conference on coordination chemistry; Moscow, USSR (25 Jun 1973). See CONF-730638-.

As a result of single crystal x-ray diffraction analysis of five complex fluorouranylates $K_3(UO_2)_2F_9$ (I), $Cs_4(UO_2)_2F_8 \cdot 2H_2O$ (II), $Rb_4(UO_2)_2F_8 \cdot 2H_2O$ (III), $Ni(NH_4)_2[(UO_2)_2F_8] \cdot 6H_2O$ (IV) and $K_3(UO_2)_2F_7 \cdot 2H_2O$ (V) it was found, that in all these structures the coordination polyhedron of U is a 7-coordinate pentagonal bipyramid UO_2F_5. Depending on the stoichiometric ratio U : F different ways of interactions between neighboring bipyramids occur. In structure I two bipyramids are bound by one bridging fluorine to form a dimeric complex $[(UO_2)_2F_9]^{5-}$. In crystals II–IV two bipyramids are joined by a common edge F–F to form a dimeric complex $[(UO_2)_2F_8]^{4-}$. In the structure V the neighboring bipyramids form infinite chains $[(UO_2)_2F_7]^{2-}_\infty$ with interactions "apex-edge-apex-edge" etc. Three-dimensional data obtained by means of KFOR-type x-ray goniometer were used in the investigations of structures I, II, III, and V. Structure IV was investigated by means of an automatic diffractometer. Structures I–V were solved by the heavy atom technique and three-dimensional Patterson and Fourier synthesis, and were refined by isotropic least-squares. (auth)

20792 CRYSTAL–CHEMICAL REGULARITIES IN THE SIMPLE AND COMPLEX FLUORIDES OF TETRAVALENT URANIUM. Zadneprovskii, G. M.; Borisov, S. V.; Gagarinskii, Yu. V. (F. E. Science Center, Vladivostok, USSR). pp 75–76 of Proceedings of the XVth International Conference on Coordination Chemistry. Moscow; Izdatel'stvo Nauka (1973).

From 15th international conference on coordination chemistry; Moscow, USSR (25 Jun 1973). See CONF-730638-.

Analyses of the structure of the fluorine and oxygen compounds of tetravalent uranium (and its analogues) revealed their main crystal-chemical regularities. Eight- and nine-apex coordination polyhedra prove to be the most typical for U^{4+}; they occur in the form of cubes or tetragonal antiprisms, and in the form of trigonal prisms with semi-octahedra on each lateral facet (i.e., in the form of tetragonal antiprisms with semi-octahedra on one of the bases). Also evident is the definite correlation of the character of the uranium coordination polyhedra coupling with the U–U bond length. The distances U–U = 4.60–4.40 Å unambiguously determine the U–polyhedra coupling with the aid of one shared apex (bridge-anion), and the distances 4.10–3.90 Å do the same for the bonds formed with the aid of a shared edge of two bridge-anions. Now, at 3.75 Å the polyhedra share the same face (i.e., have three bridge-anions). In structures with polyhedra bands or columns coupled by shared edges or faces, respectively, a clear-cut dependency of the cell dimensions upon the short U–U distances is observed: the translation vector in the direction of the uranium atom chains is generally the sum of two U–U vectors. The analysis of the bonds U–O(F) resulted in the elucidation in certain structures of the dependency of the cation-ligand bond strength upon the length of the bond. For O^{2-} and F^-, these dependencies have a similar character and are very close in value. Finally, the structure analysis shows that the effective anion volumes (18.2 Å for F^- and 19.6 Å for O^{2-}) in the various compounds are preserved with an accuracy of up to 8%. (auth)

20793 PROTON MAGNETIC RESONANCE OF COMPLEX OF URANIUM(IV) WITH GLYCINE. Miyake, C.; Imoto, S. (Osaka Univ., Japan). pp 131 of Proceedings of the XVth International Conference on Coordination Chemistry. Moscow; Izdatel'stvo Nauka (1973).

From 15th international conference on coordination chemistry; Moscow, USSR (25 Jun 1973). See CONF-730638-.

Complexes of uranium(IV) with glycine were prepared and the chemical formula of the complex was identified to be as $[U(C_2NO_2H_4)_2(H_2O)_2]Cl_2 \cdot 2H_2O$. Measurement of PMR of the complex was carried out on the D_2O solution in the temperature range 273 to 333°K. The shift observed was high field shift relative to the uncomplexed free ligand and revealed the linear relationship to the reciprocal of temperature. The shift was analyzed on the basis of crystal field model and the data of magnetic susceptibility, which obeyed the Curie-Weiss law with 3.4 effective Bohr magneton. The calculation, assuming $a_{U-O} = 2.32$ and $a_{U-N} = 2.38$ A for the atomic distances, showed the ground state to be $0.7018|4> + 0.1223|0> + 0.7018|-4>$ with the first excited state, $-0.7071|4> + 0.7071|-4>$, above about 50 cm^{-1}. The dipolar shift due to the anisotropy of the magnetic moment was estimated to be of the order of 100 ppM and the difference between the shift observed and the dipolar shift is likely to be attributed to the Fermi contact shift of high field shift. (auth)

20794 VIBRATIONAL SPECTRA IN INVESTIGATION OF THE COMPLEXES OF URANYL AND ANALOGUES. Correlations Between Spectroscopic and Energetic Parameters of Bond. Vodovatov, V. A.; Ladigin, I. N.; Mashirov, L. G.; Suglobov, D. N. pp 132–133 of Proceedings of the XVth International Conference on Coordination Chemistry. Moscow; Izdatel'stvo Nauka (1973).

From 15th international conference on coordination chemistry; Moscow, USSR (25 Jun 1973). See CONF-730638-.

UO_2^{2+} stretching frequencies are dependent on equatorial ligands number and on their donor properties. The use of stretching frequencies in such analysis is based on the assumption that these frequencies are characteristic towards the stretching force constant K_{MO}. For correct estimation of characteristic's degree it is necessary to evaluate UO_2^{2+} stretching frequency change, which is generated by kinematic and dynamic parameter variations when complex structure is changed. For these purposes a study was made of ir spectra (down to 30 cm^{-1}) and Laser-Raman spectra (including spectra of monocrystals with ^{18}O-isotopic substitutions in group UO_2^{2+}) of some uranyl complexes; normal coordinate analysis for uranyl halogenide complexes; analysis of degree in which the stretching frequencies of MO bond are characteristic toward K_{MO}. (auth)

20795 POLARIZED ABSORPTION SPECTRA OF TECHNETIUM(IV) AND RHENIUM(IV) IN TRIGONAL CRYSTAL FIELDS. Schenk, H. J.; Schwochau, K. (Institut fuer Nuklearchemie der Kernforschungsanlage, Juelich, GmbH, Germany). pp 153–154 of Proceedings of the XVth International Conference on Coordination Chemistry. Moscow; Izdatel'stvo Nauka (1973).

From 15th international conference on coordination chemistry; Moscow, USSR (25 Jun 1973). See CONF-730638-.

Dilution of complex ions in syncrystallized colorless host lattices has proved to be an excellent means of measuring electron transfer as well as ligand field spectra with enhanced resolution at low temperatures. As there has been some discussion concerning the absorption of $[ReCl_6]^{2-}$ in the near uv, polarized absorption spectra of technetium(IV) and rhenium(IV) in trigonal single crystals of $(C_2H_5NH_3)_2SnCl_6$ and $(C_2H_5NH_3)_2SnBr_6$ in the range of 8000 to 2800 Å at 77 and 298°K were recorded. (auth)

20796 SPECTROSCOPICAL ANALYSIS OF WATER COORDINATION IN URANYL COMPOUNDS. Novitskii, G. G.; Sevtchenko, A. N.; Umreiko, D. S. (Belorussian State Univ., Minsk). pp 203 of Proceedings of the XVth International Conference on Coordination Chemistry. Moscow; Izdatel'stvo Nauka (1973).

From 15th international conference on coordination chemistry; Moscow, USSR (25 Jun 1973). See CONF-730638-.

Taking into account the difference in the nature and strength of the water molecules spheres in higher hydrates of uranyl nitrate such compounds as $[UO_2(NO_3)_2 \cdot 2H_2O] \cdot nD_2O$ and $[UO_2(NO_3)_2 \cdot 2D_2O] \cdot nH_2O$ (n = 1; 4) were prepared. The DTA method was used to obtain data indicating heavy water in such systems is a more active ligand than in common water. (auth)

20797 THORIUM 8-HYDROXYQUINOLATES. Wallace, W. J.; Golub, A. M.; Dabeka, R. W. (Univ. of Saskatchewan, Canada). pp 292–293 of Proceedings of the XVth International Conference on Coordination Chemistry. Moscow; Izdatel'stvo Nauka (1973).

From 15th international conference on coordination chemistry; Moscow, USSR (25 Jun 1973). See CONF-730638-.

The following coordination compounds of thorium with 8-hydroxyquinoline (HOx) were prepared: $ThOx_4 \cdot DMF$; $ThOx_4 \cdot DMA$; $ThOx_4 \cdot C_2H_5COCH_3$; $ThOx_4 \cdot C_6H_5N$; $ThOx_4 \cdot CH_3OH$; $ThOx_4 \cdot C_2H_5OH$; $ThOx_4 \cdot C_2H_5SH$. In addition to these, a bright orange-red pentakis-8-hydroxyquinolate of thorium was synthesized. The compound, believed to be a coordinational isomer of the classical yellow-orange pentakis complex, has a sharply differing infrared spectrum. The abundance of infrared bands in the 700–900 cm^{-1} region and the color of the red compound, combined with the absence of a band at 3400 cm^{-1}, suggest close similarities between it and the uranyl(VI) tris-8-hydroxyquinolate. (auth)

20798 UREA, DIMETHYLSULFOXIDE, AND AMINE THORIUM COMPLEXES. Molodkin, A. K.; Ivanova, O. M.; Balakaeva, T. A.; Beliakova, Z. V.; Kharitonov, Yu. Ya.; Nephedov, V. I. (Inst. of General and Inorganic Chemistry, Moscow). pp 332–333 of Pro-

ceedings of the XVth International Conference on Coordination Chemistry. Moscow; Izdatel'stvo Nauka (1973).

From 15th international conference on coordination chemistry; Moscow, USSR (25 Jun 1973). See CONF-730638-.

Reactions of different thorium compounds with urea, dimethylsulfoxide, and amines were studied. Thorium compounds containing 2 to 12 neutral molecules of $CO(NH_2)_2$ and $(CH_3)_2SO$ coordinated by thorium through oxygen atom were isolated from aqueous–alcoholic solutions and by direct interreaction of hydrated thorium salts and urea or dimethylsulfoxide. Formation of these compounds was shown to take place due to displacement of water molecules and acidic ligands by urea or dimethylsulfoxide molecules in the internal sphere of thorium complexes. Reactions of thorium nitrates, oxalates, and halogenides with some amines were studied. (auth)

20799 PHTHALOCYANINE THORIUM AND URANIUM COMPLEXES. Kolyadin, A. B.; Kirin, I. S. (Leningrad Nuclear Physics Inst.). pp 356 of Proceedings of the XVth International Conference on Coordination Chemistry. Moscow; Izdatel'stvo Nauka (1973).

From 15th international conference on coordination chemistry; Moscow, USSR (25 Jun 1973). See CONF-730638-.

Mono- and diphthalocyanines complexes with the primary yield have been shown to be obtained for the interaction of adducts $MCl_4 \cdot n(C_2H_5)_2N$ (M = Th or U) with o-phthaldinitrile versus the reaction conditions. Electronic and IR spectroscopy, differential thermometric and x-ray analysis were used for the investigation of the nd- and nf-actinide element properties in the phthalocyanines complexes and mono- and diphthalocyanines of these metals. Significant simularity of the electronic and IR spectra in the number of the phthalocyanine thorium and uranium complexes is shown together with their significant differences in the number of mono- and diphthalocyanine compounds of these metals. (auth)

20800 MIXED COMPLEXES OF URANYL WITH ORGANIC LIGANDS. Nikolskai, L. E.; Inkova, E. N.; Selentsov, S. S.; Tsherbakova, L. L. pp 374-375 of Proceedings of the XVth International Conference on Coordination Chemistry. Moscow; Izdatel'stvo Nauka (1973).

From 15th international conference on coordination chemistry; Moscow, USSR (25 Jun 1973). See CONF-730638-.

The mixed complexes of uranyl with the organic ligands: o-oxyquinoline, dimethylsulfoxide, γ-butyrolactone in the presence of the anions $C_2O_4^{=}$, CH_3COO^-, F^-, $SO_4^{=}$, NO_3^- were obtained and investigated by means of physical-chemical methods. O-oxyquinoline was shown to exist both as the coordinated neutral molecule and as the uncoordinated cation $oxinH^+$ in the isolated oxalic-oxyquinoline compounds. The obtained set of DMSO-derivatives of UO_2^{++} confirms the fundamental regularity of the coordination chemistry of uranyl, namely, increasing the solidity of the bond DMSO-U and in the number of coordinated neutral molecules this set is correlated with the sequence of acid ligands in substitutional capacity in the uranyl complexes: CH_3COO^-, $C_2O_4^{=}$, F^-, $SO_4^{=}$, Cl^-, Br^-, NO_3^-, ClO_4^-. The synthesized mixed compounds of uranyl with γ-butyrolactone in accordance with IR spectra-data contain the coordinated γ-butyrolactone, and the state of its molecule depends on a coordinated anion. (auth)

20801 THERMODYNAMIC ANALYSIS OF SEPARATION PROCESSES FOR URANIUM AND PLUTONIUM HEXAFLUORIDES BY SELECTIVE CHEMICAL REDUCING AGENTS. Galkin, N. P.; Orekhov, V. T.; Rybakov, A. G. At. Energy. (USSR); 35: No. 5, 327-331(Nov 1973). (In Russian).

On the basis of published and calculated data in the interval 298 to 1000°K, there has been performed a thermodynamic analysis of 31 interactions of uranium and plutonium hexafluorides with freons of methane and ethane groups, and elements and inorganic compounds such as H_2, O_2, Cl_2, Br_2, I_2, Xe, CO_2, SF_4, and SO_2. Freon-114, Cl_2, Br_2, Xe, and CO_2 may be used as selective reducing agents for PuF_6. For the interactions of these substances with PuF_6, equilibrium constants have been calculated. The most available and universal reagent is carbon dioxide. (auth)

20802 ACTIVATION OF PALLADIUM CATALYSTS BY RARE EARTH AND OTHER OXIDES FOR THE HYDROGENATION OF CYCLOHEXANE. Ismail, S. M.; Aleem, M. A.; Ali, A. (Pakistan Council of Scientific and Industrial Research, Karachi). Rev. Roum. Chim.; 19: No. 5, 847-857(May 1974).

It has been found that small quantities of metallic oxides, mainly of the rare earth type and including, thoria, zirconia, chromia, titania, vanadium pentoxide, ceria, lanthanum oxide, praseodymium oxide, thallium oxide and samarium oxide, act as strong promoters in the hydrogenation of cyclohexene by reduced palladium at 30° and at normal atmospheric pressure. In general the activity of a constant amount of palladium on varying amounts of promoters first rises to a peak (true promoter action) and subsequently falls as the ratio of promoters to palladium is further increased. The order of activities of these promoters follows the sequence: ThO_2 > ZrO_2 > Cr_2O_3 > CeO_2 > TiO_2 > V_2O_5 > La_2O_3 > Pr_2O_{11} > Ti_2O_3 > Sm_2O_3. The degree of activation is considerable being almost five times the unpromoted value for thoria and zirconia at the peak point in the activity curves. The apparent activation energies of hydrogenation of cyclohexene in alcoholic solution have been determined at 30°. Hydrogen adsorbed by these promoted catalysts have been determined by a chemical dehydrogenation method. Activation energies observed were higher for the promoted catalysts than for reduced palladium. A variation in the palladium: promoter ratio affected both the apparent activation energy and the total volume of hydrogen adsorbed per gram of palladium. A strict logarithmic dependence of the activation energy results in the disappearance of the promoter action of the supports at low temperatures. There was no dependence of catalytic activity on the hydrogen content of these catalysts, as has been found in the case of Raney nickel except that the adsorbed hydrogen per gram of supported palladium was more than that on reduced palladium. (auth)

20803 HETEROPOLYTUNGSTATES WITH U(IV) AS CENTRAL ATOM. Synthesis and Physico-Chemical Study of the UL_2 Complex Where L = $P_2W_{17}O_{61}^{10-}$. Marcu, Gh. (Univ., Cluj); Rusu, M.; Botar, A. V. Rev. Roum. Chim.; 19: No. 5, 827-831(May 1974).

The U(IV) ion has a rapid reaction with the unsaturated heteropolyanions, forming UL_2 complexes where L = $PW_{11}O_{39}^{7-}$ and $P_2W_{17}O_{61}^{10-}$. The potassium salt of the $U(P_2W_{17}O_{61})_2^{16-}$ heteropolyanion has been isolated. The chemical analysis, the photocolorimetric study of the reaction between U(IV) and $P_2W_{17}O_{61}^{10-}$, as well as the basicity determinations of the heteropolyacid show that the U/W combination is 1/17. (auth)

20804 INVESTIGATION OF CHROMATOGRAPHIC RESOLUTIONS OF RACEMATES. P. 2. Enantiomerically Specific $^3H/^{14}C$-Double Labelled Racemates, the Basis of a New Method for the Determination of Chromatographic Resolution on Optically Active Adsorbents. Blaschke, G. (Kiel Univ. (F. R. Germany). Pharmazeutisches Inst.). Chem. Ber.; 107: No. 1, 232-236(Jan 1974). (In German).

6 refs.

The synthesis of enantiomerically specific labelled d,l-mandelic acid, d,l-methyl mandelate, and d,l-mandelamide is reported. These double labelled racemates allow rapid and very sensitive determination of chromatographic resolution. The resolution is determined by liquid scintillation counting of ^3H and ^{14}C. (auth)

20805 HYDROLYSIS OF TRANSURANIUM ELEMENTS. II. Hydrolysis of Americium(III) and Curium(III) in Pure Nitric Acid Solutions. Korotkin, Yu. S. Sov. Radiochem. (Engl. Transl.); 15: No. 5, 682-685(1973).

Translated from Radiokhimiya; 15: No. 5, 676-680(1973).

An investigation was made of the mechanism of the hydrolysis of Am and Cm in pure HNO_3 solutions up to pH ≤ 5.5. The addition of Li^+ and NH_4^+ ions to the HNO_3 suppresses hydrolysis and shifts the equilibrium toward the formation of nitrate complexes at pH < 2. At low pH values (> 4) the same operation produces the reverse effect. (auth)

20806 HYDROLYSIS OF TRANSURANIUM ELEMENTS. Study of Hydrolysis by Distribution Chromatography (UO_2^{++}, PuO_2^{++}). Korotkin, Yu. S. Sov. Radiochem. (Engl. Transl.); 15: No. 5, 677-681(1973).

Translated from Radiokhimiya; 15: No. 5, 671-676(1973).

Distribution chromatography reversed phases may be used to study hydrolysis. A chromatographic study was made of the hydrolysis of uranyl and plutonyl ions. (auth)

20807 EFFECT OF METAL COUPLING ON CONTAMINATION. Zaric, M.; Matijasic, A.; Radosavljevic, R.; Tasovac, T. (Boris Kidric Inst., Belgrade). Isotopenpraxis; 10: No. 1, 6-12 (Jan 1974).

Contamination of metals and of metal couples with ^{60}Co was studied. The effect of coupling on metal contamination was very expressive. It was concluded that under certain conditions, the contamination of metal surfaces depends not only on adsorption but also on galvanic effects. (auth)

20808 SYNTHESIS AND ANALYSIS OF [4-^{14}C] PHENYLBUTAZONE. Ayrey, G.; Yeomans, M. A. (London Univ.) J. Radioanal. Chem.; 20: No. 2, 463-471(1974).

[4-^{14}C] Phenylbutazone (4-butyl-1,2-diphenyl-3,5-[4-^{14}C] pyrazolidinedione) has been synthesized on the 5 mmole scale. [2-^{14}C] Diethyl malonate was reacted with n-butyl bromide and the product condensed with hydrazobenzene in the same reaction vessel. The radiochemical yield of highly purified product was 48%. It is proposed that care should be taken in analyses for metabolic prod-

ucts, particularly by TLC, since 4-hydroxyphenylbutazone was shown to be an oxidation product of phenylbutazone in solution and on TLC plates under mild conditions. A pure sample of 4-hydroxy-[4-^{14}C] phenylbutazone was isolated. (auth)

20809 PRODUCTS FROM REACTION OF URANOSOURANIC OXIDE WITH LEAD OXIDE IN AIR. Polunina, G. P.; Kovba, L. M.; Ippolitova, E. A. Sov. Radiochem. (Engl. Transl.); 15: No. 5, 690-693(1973).

Translated from Radiokhimiya; 15: No. 5, 684-688(1973).

Interaction of lead oxide with uranosouranic oxide in air at various temperatures was studied and the thermal stability of the compounds formed in the system $PbO-U_3O_8-O_2$ was examined. Thermal and x-ray phase analysis were the methods used mainly in the work. (LK)

20810 REACTION OF POLONIUM VAPOR WITH SOME CHEMICAL ELEMENTS. Ershova, Z. V.; Abakumov, A. S.; Malyshev, M. L. Sov. Radiochem. (Engl. Transl.); 15: No. 5, 694-698(1973).

Translated from Radiokhimiya; 15: No. 5, 688-693(1973).

Different types of processes, corresponding to the character of the interaction of the elements, are observed when polonium vapor interacts with chemical elements. Polonium vapor interacts with magnesium, indium, manganese, praseodymium, and gadolinium to form the corresponding polonides. The absorption of polonium with the formation of an alloy was observed in the interaction of polonium vapor with germanium and antimony. Polonium vapor does not react with rhenium. (auth)

20811 REACTION BETWEEN PLUTONIUM(III) AND NITROUS ACID. I. Equilibrium. Koltunov, V. S.; Marchenko, V. I. Sov. Radiochem. (Engl. Transl.); 15: No. 5, 754-756(1973).

Translated from Radiokhimiya; 15: No. 5, 748-750(1973).

It was shown that in nitric acid solutions containing Pu(III), Pu(IV), and nitrous acid, equilibrium is established between the valence forms of plutonium, which is determined by the concentration of HNO_2 and H^+ and NO_3^- ions. The constant of this equilibrium was found to equal $K = 0.93 \pm 0.05$ $M^{1.5}$ at 25°C with a solution ionic strength $\mu = 2$. The heat of reaction equals 9.0 ± 0.5 kcal/mole. (auth)

20812 INTRODUCTION OF TRITIUM INTO SOME RIBONUCLEIC ACID PRECURSORS. Vdovenko, V. M.; Bobrova, V. N.; Airapetyants, E. G.; Gordeeva, L. S.; Dedova, V. K.; Patokina, N. A. Sov. Radiochem. (Engl. Transl.); 15: No. 5, 730-736(1973).

Translated from Radiokhimiya; 15: No. 5, 726-734(1973).

A method was developed for the synthesis of nucleosides with fixed tritium labeling, namely, adenosine-8-^{3}H with a specific activity of 11 Ci/mmole, inosine-8-^{3}H (16 Ci/mmole), and guanosine-8-^{3}H (14.5 Ci/mmole), by dehalogenation of the corresponding 8-halonucleosides by tritium over 5% Pd/C catalyst. The radiochemical purity of the preparations was 98 to 99%. Conditions were developed for the preparation of indefinitely tritium-labeled inosine-(^{3}H) with a specific activity of 0.075 Ci/mmole and guanosine-(^{3}H) with a specific activity of 0.060 Ci/mmole by isotopic exchange. A method was developed for the synthesis of adenosine-8-^{3}H-5′-monophosphate (lithium salt) with a specific activity of 5 Ci/mmole. By deamination of AMP-8-^{3}H we obtained inosine-8-^{3}H-5′-monophosphate (sodium salt) with an activity of 0.22 Ci/mmole. An enzymatic method was developed for preparing sodium adenosine-8-^{3}H-5′-triphosphate with a specific activity of 0.42 Ci/mmole. (auth)

20813 CHEMICAL CONSEQUENCES OF ELECTRON CAPTURE OF ^{125}Xe IN BUTANE AND EFFECT OF RADIOLYSIS ON THE STABILIZATION FORM OF ^{125}I DAUGHTER ATOMS. Zaitsev, V. M.; Serova, V. A.; Tikhonov, V. I. Sov. Radiochem. (Engl. Transl.); 15: No. 5, 768-770(1973).

Translated from Radiokhimiya; 15: No. 5, 758-760(1973).

By means of radiogaschromatographic analysis the yields of compounds labeled with ^{125}I formed by the decay of ^{125}Xe in butane were determined under different conditions. The liquid-phase radiolysis of butane at −15°C in the presence of $5 \cdot 10^{-3}$ M I_2 was studied to determine the effect of radiolytic factors, which influence the form of stabilization of ^{125}I atoms in electron capture. (LK)

20814 ISOLATION OF THALLIUM(I) DIAQUODIOXALATODIOXOURANIUM(VI) AND ITS THERMAL BEHAVIOR. Aravamudan, G.; Venkataraman, T. B. K.; Giridharan, A. S.; Raghuchandra Kini, M. (Indian Inst. of Tech., Madras). Proc. Indian Nat. Sci. Acad., Part A; 38: No. 3-4, 120-124(1972).

$Tl_2[UO_2(C_2O_4)_2(OH_2)_2]$ was prepared and characterized by chemical analysis, X-ray diffraction, and IR spectroscopy. On thermolysis in air, the compound gave at 300°C, Tl_2UO_4, which on prolonged keeping in air in the range of 300°–500°C, was converted into a mixture of thallic oxide and thallium (I) diuranate. Again at 580°C, the thallic oxide and thallium diuranate mixture was transformed back into Tl_2UO_4. Vacuum decomposition studies of the oxalate were also made. (auth)

Radioactive Waste Treatment

Refer also to abstracts 21178 and 21873.

20815 (SZS-159) SORPTION REACTION OF RADIOIODINE AND ITS SEPARATION FROM GASEOUS WASTES OF NUCLEAR PLANTS. Anders, G.; Schwarzbach, R. (Staatliche Zentrale fuer Strahlenschutz, Berlin (German Democratic Republic)). May 1974. 32p. (In German). Dep. NTIS (US Sales Only) $4.75.

The literature survey deals with the adsorption of iodine and methyl iodide by different solids, molecular sieves, and activated carbon as well as the absorption by liquids. At present activated carbon is frequently used. By reason of the higher temperature stability inorganic molecular sieves treated with silver nitrate will be used in future too. A review is also given on the developmental state of iodine retention from gaseous wastes released from nuclear power plants in normal operation and accidental situations. The removal of radioiodine from waste gases of reprocessing plants now in operation is described. Possibilities of improvement are discussed. (auth)

20816 LATEST DEVELOPMENTS IN SOLIDIFICATION OF RADIOACTIVE WASTES. Emura, S. (Japan Atomic Energy Research Inst., Tokai); Abe, H. Genshiryoku Kogyo; 20: No. 1, 25-32(Jan 1974). (In Japanese).

Recent development in solidification of radioactive wastes is reviewed with emphasis on the studies of mechanical behavior of solidified wastes and percolation tests on radioactive nuclides being conducted in Japan. In the first part, the mechanical behavior of cement-solidified wastes under high water pressure is summarized. The relation between the compressive strength of solids and the content of wastes is shown for various types of wastes from power plants such as concentrated liquid, used ion-exchange resins, and filter sludge. Cement-solidification, mixer method, in-drum mixing, injection method and other methods are explained. The strength of various types of container against water pressure up to 500 kg/cm^2 is also discussed on the basis of the results of experiments. As for the percolation test, the outline of method is briefly explained. In the second part, many techniques for waste solidification being developed in the world are reviewed. They include drying of concentrated liquid waste, solidification with asphalt and solidification with plastic materials. Economic comparison among three types of disposal (drying, cement and asphalt solidification for radioactive wastes from LWRs is presented, and the result is that the cement-solidification is most expensive. (JA)

20817 MANAGEMENT OF RADIOACTIVE GASEOUS WASTES. Murata, T. (Hitachi Ltd., Ibaraki, Japan). Genshiryoku Kogyo; 20: No. 1, 33-38(Jan 1974). (In Japanese).

The release of radioactive gaseous wastes from nuclear power plants and their management is described. The 1970 annual record on the release of radioactive rare gases and halogens from the LWR plants in USA is shown. It is explained that the difference of release rate between PWRs and BWRs is due to the difference in rare gas hold up time, and that the release rate from BWRs can be decreased by the factor of 100 or 1000 by the installation of a new rare gas hold-up system. The estimated rare gas release rate from the PNC's reprocessing plant is also cited, and it is 8×10^3 Ci/d, mainly due to ^{85}Kr. As the method of eliminating short-life radioactive rare gas, the hold-up system using active carbon is reviewed with emphasis on the temperature dependence of adsorption coefficient. For the elimination of ^{85}Kr, the distillation method, adsorption by active carbon, solvent absorption, diaphragm process, and other methods are reviewed. The flow sheets for and comparison of these processes in terms of development, advantages, and defects are given. For the elimination of radioactive iodine in the normal operation of power plants, the study by Wilhelm et al. is cited. As the management problem at the time of reactor accidents, the removal of methyl iodide is discussed referring to the reports by Postma and Pence et al. Finally, some proposed methods for removing ^{3}H are explained. (JA)

20818 REMOVAL OF ^{137}Cs FROM AQUEOUS SOLUTIONS BY ZEOLITE. Kato, K. (Japan Atomic Energy Research Inst., Tokai). Hoken Butsuri; 9: No. 1, 11-16(Mar 1974). (In Japanese).

For the purpose of using zeolite together with polymer coagulant in the chemical treatment of low-level radioactive liquid wastes, experiments were carried out on the removal of ^{137}Cs by natural

zeolite under different conditions. Cation exchange capacities of natural zeolites produced in Japan were determined in powdered condition by the batch method. Results obtained show that cation exchange capacities of natural-zeolites, clinoptilolite, and mordenite are 134 to 156 meq Cs^+/100g and 170 to 183 meq Cs^+/100 g, respectively. The removal of ^{137}Cs by the zeolite, which had the highest cation exchange capacity among those tested, was studied. The removal efficiency of both natural and Na-form zeolite was more than 95% under the following condition: concentration of 500 ppM, pH of 2 ~ 11, Na^+ < 250 ppM, K^+ < 50 ppM, NH_4^+ <25 ppM, Ca^{2+} <1,000 ppM and Cs < 10^{-4} M/*l* as a carrier. The removal efficiency from tap water was about 99% with 250 ppM of zeolite. The combined use of 500 ppM zeolite and 5 ppM nonionic polymer coagulant was particularly effective for the removal of ^{137}Cs. (auth)

20819 METHODS OF FISSION PRODUCT SEPARATION FROM LIQUID RADIOACTIVE WASTES. Kourim, V.; Vojtech, O. (Nuclear Research Inst., Rez, Czech.). At. Energy Rev.; 12: No. 2, 215-273(1974).

The fission products present in burnt-up nuclear fuel represent a troublesome and dangerous by-product of nuclear energy but also a potentially useful source of nuclear radiation. The review is concerned with the present situation and with forecasts concerning increases in the amount of fission products, their nuclear and chemical properties, their applications and methods of separating them from highly active wastes. Particular attention is paid to the most recent and promising methods. (370 references) (auth)

Radioisotope Production

Refer also to abstracts 21331, 22629, 22841, and 22842.

20820 (JAERI-M-1232) DEVELOPMENT OF TECHNIQUES OF ^{131}I PRODUCTION. Amano, H.; Shikata, E.; Iguchi, A.; Izumo, M.; Suzuki, K. (Japan Atomic Energy Research Inst., Tokyo). Dec 1973. 61p. (In Japanese). INIS.

The technical development of ^{131}I production started in 1957. After the first study on the extraction and distillation of ^{131}I from aqueous solutions of irradiated metallic tellurium, the development progressed in the distillation of ^{131}I from sulfuric acid solution of irradiated telluric and polymetatelluric acids in large quantities. On the basis of data obtained therein, production facilities were constructed in the Radioisotope Production Laboratory, where 10 Ci of ^{131}I at the maximum could be processed. During the period from 1967 to 1971, 60 runs of production were carried out, where polymetatelluric acid irradiated in JRR-2 and -3 was used. Through these runs were gained experiences important health-physically for the operation and maintenance of the exhaust gas purification system attached to such facilities, where large quantities of ^{131}I were processed. In 1970 the technical development was commenced to produce ^{131}I from tellurium dioxide irradiated in JMTR, and the method established therein substituted the former polymetatelluric acid method in 1971. In parallel with the wet procedures, the dry-distillation was also studied. The study included the elucidation of the mechanism by which ^{131}I was liberated on heating from irradiated tellurium dioxide. An attempt was made to dry-distill ^{131}I from tellurium compounds other than the dioxide to recover ^{131}I more efficiently, and this revealed the possibility of using a new tellurium oxide Te_3O_{11}, which liberated ^{131}I rapidly and almost quantitatively, instead of the dioxide. (auth)

20821 (JAERI-M-5568) LARGE ^{60}Co SOURCES TEST PRODUCTION WITH JRR-3. Tachikawa, K.; Kato, H.; Genka, T.; Ito, T. (Japan Atomic Energy Research Inst., Tokyo). Feb 1974. 58p. (In Japanese). NTIS (US Sales Only).

To establish the production techniques of Co-60 radiation sources with high activity, the wafer targets (8.3 mmϕ × 2.3 mm, 1.1 g) were irradiated in the VC irradiation hole of JRR-3 for three years. After irradiation for 7,300 hours in a neutron flux of 2×10^{13} n/cm^2·sec., the activity of the cobalt attained 2.2 kCi, with specific activity from 3.3 to 4.2 Ci/g. The whole procedure, including decanning, activity measurement and encapsulation, was performed in a 65-cm-thick heavy concrete cave in three batches. Through the test production, considerable knowledge could be obtained on such as irradiation method, handling of high active materials, disposal of radioactive waste, decontamination, source assemblage, remote handling and effective usage of a multi-purpose hot cell. (auth)

20822 EQUIPMENT FOR PRODUCTION OF RADIOACTIVE ISOTOPES. Hruby, J. Czech Patent 146,474. 15 Dec 1972. Filed date 31 Dec 1971. 2p.

Equipment is proposed for the production of radioisotopes, mainly for the production of ^{18}F. The equipment is designed for the removal of gaseous wastes resulting from the irradiation of water with charged particles. (Nuclear Sci. Abstr. Czech.)

20823 PRODUCTION OF $^{11}CO_2$ FOR USE IN PLANT TRANSLOCATION STUDIES. More, R. D.; Troughton, H. (Dept. of Scientific and Industrial Research, Lower Hutt, N. Z.). Photosynthetica (Prague); 7: No. 3, 271-274(1973).

Deuterons from a 3.0-MeV Van de Graaff accelerator were used in the $^{10}B(d,n)^{11}C$ reaction to produce ^{11}C for studies of carbon translocation in plants. Included in the technique were: the use of a solid ^{10}B enriched target, oxygen as a reactant and as a sweep gas, and a differential pumping system. Gases from the target were passed over CuO wire in a furnace at 600°C to convert $^{11}CO_2$, and the $^{11}CO_2$ was separated from other gases by a liquid oxygen trap. Yields of 10 mCi of $^{11}CO_2$ were recovered following a 30-min irradiation with a beam of 2.75-MeV deuterons and a current of 30 μA. $^{11}CO_2$ produced by this method was used in translocation experiments with maize leaves. Yields as low as 0.2 mCi of $^{11}CO_2$ gave sufficiently well-defined ^{11}C pulses to allow calculation of both the speed of translocation and the pulse width at half maximum height. (Nuclear Sci. Abstr. Czech.)

20824 PURIFICATION OF RADIOZIRCONIUM AND THE INFLUENCE OF ACCUMULATION OF DAUGHTER RADIOACTIVITY ON THE ACCURACY OF ITS DISTRIBUTION MEASUREMENTS. Caletka, R. (Nuclear Research Inst., Rez, Czech.); Kotas, P. J. Radioanal. Chem.; 20: No. 2, 541-548(1974).

The use of nuclide ^{95}Zr as radiotracer is often unfavorably influenced by the continuous accumulation of the radioactive daughter nuclide ^{95}Nb. A method is given showing how the daughter radioactivity can influence the value of the distribution coefficient of zirconium calculated from radioactivity measurements. A simple method of continuous purification of ^{95}Zr, which yields a product of the required degree of purity, is also described. (auth)

20825 SEPARATION OF RADIOACTIVE ISOTOPES ^{131}Cs AND ^{131}Ba. Abrarov, O. A.; Sultanov, A. S.; Aminova, M. (Inst. of Nuclear Physics, Tashkent). Dokl. Akad. Nauk Uzb. SSR; No. 8, 21-22(1973). (In Russian).

The ^{131}Cs in reactor-irradiated $^{131}Ba(No_3)_2$ was recovered after 15 days cooling, from nitric acid solution with dioxane. The only impurity in the product was small amounts of ^{131}Ba. (TTT)

Reactor Fuel Reprocessing

Refer also to abstract 21095.

20826 (ARH-SA-183) DECONTAMINATION OF OBSOLETE PROCESSING FACILITIES AT HANFORD. Foster, C. B.; Szulinski, M. J. (Atlantic Richfield Hanford Co., Richland, Wash. (USA)). 1 Jun 1974. Contract AT(45-1)-2130. 32p. (CONF-740608-15). Dep. NTIS $4.75.

From annual meeting of the American Nuclear Society; Philadelphia, Pennsylvania, USA (23 Jun 1974).

At termination of operations the initial cleanout of the $BiPO_4$ plant consisted of flushing the process equipment with 60% nitric acid and of processing these acid flushes for recovery of the plutonium. Following these acid flushes, the cells were spray flushed with water. The equipment was then flushed with alkaline permanganate, alternating with nitric acid solution, by filling the tanks to overflow and allowing the solutions to flow down over the external surfaces of the tanks. After circulating the solutions through the precipitation tank, centrifuge, catch tank, and solution tank in each process section, and flushing the floor, the solutions were adjusted to an alkaline pH, and pumped to the underground storage tanks. Each cell was then cleaned with steam and alkaline permanganate. The remote maintenance crane directed the steam jet. The task was completed with operations from the deck level. Radiation levels at this time were 100 to 500 mrad/h in the process cells, with spot readings as high as 10 rad/h. Nine years later the decontamination was completed by sand blasting. The Redox Plant was decontaminated by first removing the hexone solvent and then flushing the process vessels with 57% nitric acid containing 1% boric acid. Sludges were dissolved in a solution of 20% nitric acid containing 6% ammonium fluoride and 1% boric acid. Decontamination flushes were essentially a two-phase treatment in each of two categories: (a) internal to vessels and piping, and (b) external to vessels and piping, including the process cells. Operations and materials used in this two-phase treatment included flushes with an alkaline permanganate solution of 1% potassium permanganate in a 25% solution of sodium hydroxide water and a 10% nitric acid solution. The canyon deck was flushed prior to the external flushing of the cells and equipment. The two systems used were the canyon washdown facility to remove dust and loose contamination, and a remotely operated spray device that applied decontamination solutions. The decontamination

solutions and water flushes were applied through a flat nozzle, at about 30 gal/min at 150 lb/sq in. The canyon deck was first sprayed with a solution of 1% potassium permanganate in 25% sodium hydroxide, followed by water, then a 2.5% solution of oxalic acid, and finally water. After the canyon deck was flushed, the same procedure was used to flush the inside of the canyon cells and exterior surfaces of the cell hardware. Decontamination solutions were concentrated and stored in underground tanks. At the termination of decontamination operations in 1967, radiation levels in the process cells were estimated to range up to 500 rad/h. Predecontamination levels were in excess of 1000 rad/h. Radiation background levels, measured 3 ft above the canyon deck with the process cells closed, were reduced from 2 to 0.4 rad/h. Spot maximum levels were reduced from 500 to 5 rad/h with an isolated spot as high as 150 rad/h. The objective of placing the plant in safe shutdown condition, under surveillance, was achieved. Plutonium-contaminated facilities were also decontaminated at Hanford. One was the disassembly and process area decontamination of the Recuplex facility, a solvent-extraction process for recovery of plutonium from scrap. The task of recovering this process area for reuse was accomplished in three phases: flushes of equipment and glove boxes, to recover gross plutonium; disassembly of equipment and glove boxes, packaging, and storage; and final cleanup of room. Nitric acid and nitric–hydrofluoric acid mixtures were used to flush equipment and glove boxes. Cruds were removed physically. Residual loose contamination was fixed with three coats of latex paint. The glove boxes, etc., were then cut into small pieces that could be readily handled and buried. The remaining surfaces were then decontaminated by hand scrubbing until the plutonium level was <1000 dis/min per 100 cm^2, or was acceptably low and nonsmearable. This latter situation was characterized by a few spots of 20,000 dis/min per 100 cm^2, after decontamination efforts had penetrated all layers of paint and had removed some of the base concrete. The task was completed by repainting with three or four coats of Amercoat 33®, and meticulously resurveying. (auth)

20827 (CNEA-EN-37/110) REPROCESSING, STORAGE, AND TRANSPORT COSTS OF IRRADIATED NATURAL URANIUM FUELS IN ARGENTINA. Kaufmann, F. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). Sep 1973. 107p. (In Spanish). INIS.

Reprocessing, storage, and transport costs are analyzed for natural uranium fuels for Argentine reactors. Characteristics and costs for optimized plants are given related to their year of start-up and to the rate of increase of irradiated fuel element production. An economic evaluation of five possible ways for treatment of irradiated fuel elements is given: permanent storage, selling, reprocessing in a local plant with and without previous storage. (auth)

20828 (DOCKET-50332-40) BARNWELL NUCLEAR FUEL PLANT. Separations Facility, License Application, FSAR, Volume 1, Appendix. (Allied-Gulf Nuclear Services, Barnwell, S. C. (USA)). 1974. 455p. Dep. NTIS $25.75.

Volume 1 Appendix contains subsurface study reports, seismic structural analysis; settlement report of critical structures and sand-fill around waste tanks; effects of variations in soil moduli on process building soil springs; effect of dewatering under FRSS pools; nuclear criticality safety analysis for fuel receiving and storage station; consultant reports; design bases; shielding summary report; summary of safety-related instrumentation; and radioactive gaseous effluents from Barnwell Nuclear Fuel Plant separations facility. (LK)

20829 (DOCKET-50332-41) BARNWELL NUCLEAR FUEL PLANT. Separations Facility, License Application, FSAR, Volume 2. (Allied-Gulf Nuclear Services, Barnwell, S. C. (USA)). 1974. 373p. Dep. NTIS $21.75.

Volume 2 contains three sections: introduction and general description of facility; site characteristics; and design criteria: structures, components, equipment, and systems. (LK)

20830 (DOCKET-50332-42) BARNWELL NUCLEAR FUEL PLANT. Separations Facility, License Application, FSAR, Volume 3. (Allied-Gulf Nuclear Services, Barnwell, S. C. (USA)). 1974. 555p. Dep. NTIS $30.75.

Volume 3 contains two sections: process systems and plant facilities. (LK)

20831 (DOCKET-50332-43) BARNWELL NUCLEAR FUEL PLANT. Separations Facility, License Application, FSAR, Volume 4. (Allied-Gulf Nuclear Services, Barnwell, S. C. (USA)). 1974. 504p. Dep. NTIS $28.25.

Volume 4 contains six sections: engineered safety features; instrumentation and control; waste management; waste cooling system; electric power; and auxiliary systems. (LK)

20832 (DOCKET-50332-44) BARNWELL NUCLEAR FUEL PLANT. Separations Facility, License Application, FSAR, Volume 5. (Allied-Gulf Nuclear Services, Barnwell, S. C. (USA)). 1974. 274p. Dep. NTIS $16.75.

Volume 5 contains sections on: radiation protection; conduct of operations; initial tests and operations; safety and accident analyses; technical specifications; and quality assurance. (LK)

20833 (DOCKET-50332-45) BARNWELL NUCLEAR FUEL PLANT. Separations Facility, Technical Description in Support of Application for FRSS Operations, July 1974. (Allied-Gulf Nuclear Services, Barnwell, S. C. (USA)). Jul 1974. 419p. Dep. NTIS $24.00.

Facility system and component description, nuclear criticality safety, radiological safety, nuclear materials management, administrative procedures, operating procedures, facility checkout, emergency plan and procedures, accident analysis, environmental considerations, and technical specifications are discussed. (LK)

20834 (DOCKET-50332-46) BARNWELL NUCLEAR FUEL PLANT. License Application, FSAR, Amendment 9. (Allied-Gulf Nuclear Services, Barnwell, S. C. (USA)). 16 Jul 1974. 88p. Dep. NTIS $7.50.

20835 (JUL-1041-CT) DEVELOPMENT OF A METHOD FOR THE COMBUSTION OF THE GRAPHITE OF IRRADIATED HTR FUEL ELEMENTS IN A FLUIDIZED BED FREE OF INERT SUBSTANCES. Boehnert, R. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Chemische Technologie). Jan 1974. 118p. (In German). INIS.

50 figs.; 7 tabs.; 65 refs. With abstract.

The combustion of the graphite of nuclear fuel elements in a fluidized bed free of inert material, with fluidized bed material consisting only of the ground fuel element material, is proposed as a head-end process for the reprocessing of graphite-base HTGR nuclear fuel and the results of both theoretical and experimental studies are given. The flow medium used in this fluidized bed is either pure oxygen or a mixture of oxygen and carbon dioxide. The top surface of the material layer formed by sedimentation of the nuclear fuel particles at the bottom of the reactor serves as the active surface in this process. Removal of the powdered fuel from the fluidized combustion bed by pneumatic recycling into the combustion zone of the reactor is satisfactory. It is shown that all process steps such as grinding, apportioning, combustion, and discharge of the heavy-metal ashes have to be well adjusted in order to achieve uniform, continuous combustion of the fuel element graphite in the fluidized bed. The studies carried out for this purpose as well as the results obtained are described. (GE)

20836 (KFK-1945) CALCULATIONS AND COMPILATIONS OF COMPOSITION, RADIOACTIVITY, THERMAL POWER, GAMMA AND NEUTRON RELEASE RATES OF FISSION PRODUCTS, AND ACTINIDES OF SPENT POWER REACTORS FUELS AND THEIR REPROCESSING WASTES. Haug, H. O. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Heisse Chemie). Apr 1974. 50p. Dep. NTIS (U. S. Sales Only) $5.50.

Calculations have been performed for the element and nuclide composition, radioactivity, thermal decay power, gamma and neutron release rates of the isotopes present in fuel element cladding and structural parts, spent fuels, and wastes as a function of time after reactor discharge or after reprocessing, respectively. The results are compiled in diagrams and tables for the following 1000 MW_e reference reactor designs and equilibrium fuel cycles: LWR, 3.3% enriched U, 34000 MWd/t heavy metal; LWR, 4.5% enriched U, 45300 MWd/t; LWR, first and second Pu recycle and about 19% of fissile charge Pu. (auth)

20837 (KFK-EXT-9/74-1) AUTOMATION IN THE ANALYSIS OF NUCLEAR FUELS. A Literature Review from "Nuclear Science Abstracts". Nessi, B.; Groll, P. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Heisse Chemie). May 1974. 30p. (In German). Dep. NTIS (U. S. Sales Only) $4.50.

This report is a compilation of references from Nuclear Science Abstracts (NSA) from Volume 21, Number 1 through Volume 28, Number 7. (auth)

20838 MONITORING OF RADIOACTIVE EFFLUENTS FROM HTR-FUEL REPROCESSING PLANTS AND STORAGE FACILITIES. Fliss, P.; Laser, M.; Merz, E.; Wolf, J. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Chemische Technologie). 1974. 13p. (AED-CONF-74-157-009). INIS.

From seminar on the monitoring of radioactive effluents; Karlsruhe, Ger. (14 May 1974).

The principal gaseous wastes in reprocessing of fuel elements

from high-temperature gas-cooled reactors (HTR's) arise from the head-end combustion step, from the fuel dissolution operation, from fission product solidification, and from the air used to ventilate hot cell facilities including spent fuel storage. Radioactive particulates and aerosols may be involved as well as iodine-131, iodine-129, tritium and radioactive noble gases such as krypton-85. Emissions of particulate and entrained radioactivity as well as krypton and tritium are kept to a low level by using specially designed gas cleaning and retainment equipment. In order to attain a better internal process control and also a higher detection sensitivity a special monitoring system is proposed for the gaseous effluents from a HTR-reprocessing plant. The main feature is the independent measurement of the few crucial undiluted off-gas streams close to their origin of generation in correlation with the central stack monitoring. Details of the particular measurements and procedures are presented. (auth)

20839 INVESTIGATIONS OF NITRIDATION AND HYDROCHLORINATION AS BASIC REACTIONS OF PROCESSES BEFORE REPROCESSING OF NITRIDE NUCLEAR FUELS. III. Hydrochlorination of Nitride Nuclear Fuels. Tschirne, G.; Hermel, W. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Kernenergie; 17: No. 5, 145-150(1974). (In German).

Starting from thermodynamic considerations the behavior of nitride nuclear fuels in their reaction with hydrogen chloride has been investigated. In connection with this, the composition of final product was determined as a function of the conditions existing during hydrochlorination of UN, U_2N_3, and (U, Ce)N with dilute hydrogen chloride, in the temperature range from 350 to 500°C. On account of their composition the hydrochlorination products of UN and (U, Ce)N have a smaller tendency to sintering than nitrided nuclear fuels. The possibility of separating uranium and plutonium by high-temperature hydrochlorination is examined. (auth)

CONTROLLED THERMONUCLEAR RESEARCH

Confinement and Heating

20840 (COO-3421-9) EXPERIMENTAL AND THEORETICAL INVESTIGATION OF AN INERTIAL, ELECTROSTATIC CONFINEMENT DEVICE. Final Report, June 15, 1969–June 15, 1973. Klevans, E. H.; Robinson, J. W. (Pennsylvania State Univ., University Park (USA)). 1973. Contract AT(11-1)-3421. 72p. Dep. NTIS $6.75.

The possibility of a fusion reaction among charged particles trapped in a potential well has been the motivation for experimental and theoretical studies of well formation in spherically symmetric systems. Microwave cavity resonance shifts, electron beam deflection measurements, and spectral line intensity data have provided information as to electron distribution, temperature and well formation. With ion injection at pressures from 0.5 to 5m torr, shallow wells which trap electrons (up to 4×10^9 cm^{-3}) are formed with accelerating voltages of 0.5 to 10 kV and currents of 10 to 20 mA. These wells are consistent with theoretical calculations which indicate also that deep wells are feasible at lower pressures where charge exchange is not prevalent. When electrons are injected at pressures from 0.5 to 5m torr, densities up to 7×10^9 cm^{-3} are measured and data trends are indicative of well formation in the range from 60 to 100 mA where accelerating voltage varies from 100 to 400. At pressures near 1μ torr, theoretical predictions of well formation establish a criterion based on perveance ($\gtrsim$0.1) which is found to hold in practice. Instabilities that may be present are considered and a water-bag theory to study these instabilities is discussed. Various theories of Hirsch's ion injection experiments are examined relative to their appropriateness for explaining his neutron outputs. (auth)

20841 (EUR-CEA-FC-715) SPECTROSCOPIC DETERMINATION OF PARTICLE CONFINEMENT TIMES IN TFR TOKAMAKS. Breton, C.; Mattioli, M.; Ya'akobi, B. (Association Euratom–CEA, Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Groupe de Recherches sur la Fusion Controlee; CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee). Dec 1973. 23p. (In French). Dep. NTIS (US Sales Only) $4.25.

An attempt was made to establish the confinement time τ_p of a TFR Tokamak in order to determine the diffusion coefficient and to establish the diffusion regime within the device. The investigations were based on the absolute measurement of the intensity of the D_β line of deuterium. The parts played by the diaphragm and impurities in the functioning of the device were analyzed. The diaphragm was found to be very important in recycling processes. The measurement of neutral particles at the diaphragm together with the characteristic axial growth length established its function in the processes taking place. Impurities do not have any secondary effects. The confinement time was found to be between 10 and 20 ms, the lower limit probably being rather pessimistic. The diffusion coefficient deduced is very much greater than the neoclassical coefficient. The model used for the impurities indicates a constant flux corresponding to a final proportion of 10% oxygen or 2% molybdenum with respect to the prevailing axial electron density. (FR)

20842 STELLARATOR CONFINEMENT OF LASER PRODUCED PLASMA. Scott, C. M. Austin, TX; University of Texas (1974). 132p. University Microfilms Order No. 74-14,763.

Thesis (Ph. D.).

A closed confinement system, a small l = 3 stellarator, was filled with laser-produced plasma. The plasma was produced using a Q-switched ruby laser delivering a 2 Joule, 15 nanosecond pulse, focused onto approximately 200 microns of a large LiH chip located outside the separatrix, the last closed magnetic surface. The plasma properties were obtained with a double Langmuir probe and a 4 mm microwave interferometer. The plasma confinement time was then studied as a function of the ratio of the helical to toroidal winding currents. Electron temperatures and densities on the order of 10 eV and 10^{13} cm^{-3} were obtained and confined with a magnetic field of approximately 7 kg for about 300 microseconds. The toroidal magnetic field was pulsed with the peak occurring at 314 μsec and after crowbarring possessed an e-folding time of approximately 445 μsec. The helical field had its peak at 292 μsec and possessed an e-folding time of approximately 450 μsec. Because of these differences, the separatrix varied slightly with time. A double Langmuir probe was used to obtain the electron temperature and density profiles with a 4 mm microwave interferometer being used to obtain the plasma density. Because the probe voltage was not swept, several firings of the stellarator were needed to obtain a V–I characteristic for the probe. To obtain the temperature from the V–I characteristic, a "theoretical" expression was derived and fitted to the experimental probe data by the method of Least-Squares. In reducing the microwave data, it was shown that most of the losses are due to refraction. Using this fact and assuming a uniform density profile, an expression was obtained for the received microwave signal. The experimental confinement times were compared to the theoretical confinement times given by neoclassical and pseudoclassical theory and to the Bohm time. The experimental confinement times exceeded the Bohm time in all instances by at least a factor of 4 and was exceeded by the neoclassical time by at least a factor of 20 in all cases. If ^2C were set equal to one in the pseudoclassical diffusion rate (1), then the pseudoclassical confinement time was approximately equal to or smaller than the experimentally obtained confinement time. (Diss. Abstr. Int., B)

20843 OBSERVATIONS OF PLASMA DENSITY AND POTENTIAL STRUCTURE IN A TOROIDAL OCTUPOLE MAGNETIC FIELD. Drake, J. R. Madison, WI; University of Wisconsin (1973). 171p. University Microfilms Order No. 74-9175.

Thesis (Fh. D.).

Gun-generated plasmas ($n \cong 5 \times 10^9$ cm^{-3}, kT_i = 1 to 40 eV, kT_e = 2 to 10 eV) and microwave-generated plasmas ($n \cong 5 \times 10^9$ cm^{-3}, kT_i = 2 to 10 eV, kT_e = 2 to 10 eV) were studied with Langmuir probes used as the primary diagnostic. The levitated octupole is suitable for studying intermediate-temperature, collisionless plasmas in a support free and relatively error free environment. The octupole can be operated in either a minimum average B, MHD-stable, purely-poloidal field configuration or a configuration with a toroidal field. A model was developed for low-dielectric plasma density evolution in a pulsed field which included electrostatic electric fields and the resulting azimuthal motion of particle-bearing field lines inside the psi-critical. The results of attempts to incorporate the model indicated that the inclusion of the azimuthal direction in the evolution model provided better agreement between observed and extrapolated density profiles than previously used purely two-dimensional models. A Fick's Law determination of the diffusion coefficient showed that the losses to a hoop were 5 to 10 times less than Bohm diffusion losses and that the shape of the observed density profile was inconsistent with a B^{-1}-dependent diffusion coefficient. The Okuda–Dawson diffusion model demonstrated better consistency but the results were inconclusive. Surveys of azimuthally dependent structures were made to distinguish between $\vec{E} \times \vec{B}$-convective transport and diffusion. Observed closed potential contours capable of trapping a substantial fraction of the particle distributions were associated with support obstacles and, for the support free case, with undetermined mechanisms probably related to the asymmetries characterizing the insulated poloidal field gap. The $\vec{E} \times \vec{B}$ circulation time around the contours was longer than the generation time of the contours. Local enhanced losses to the conducting surfaces in the vicinity of the gap were related to observed electric fields in the plasma. The addition of a toroidal field suppressed both the potential structure in the private flux region and the losses to the hoop. Convective E × B transport due to peak-to-peak azimuthal potential variations of the order of kT_e over lengths of the order of 0.1 m was shown to be equal to Bohm diffusion transport thus indicating the importance of distinguishing between convective and diffusion-derived transport. (Diss. Abstr. Int., B)

20844 PLASMA PARAMETERS IN A MAGNETOPLASMA COMPRESSOR IN THE COMPRESSION ZONE. Berkov, V. I.; Morozov, A. I. JETP Lett. (USSR) (Engl. Transl.); 19: No. 1, 32-33(5 Jan 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 19: No. 1, 52-54(5 Jan 1974).

An investigation was made of a magnetoplasma compressor using a bank of low energy ($\lesssim$30 kJ) but having parameters of practical interest, viz., quasistationary plasma lifetime $\tau \sim 40$ μsec, jet length $L \gtrsim 2$ m, jet macroscopically stable, flow divergence $\theta < 10°$, impurity concentration in the central compression zone $\alpha \lesssim 0.5\%$, $T_e \leq 11$ eV, $N_e \lesssim 5 \times 10^{17}$ cm^{-3}, and $W_i \lesssim 200$ eV. Regimes are observed in which half the energy fed to the discharge is released in the form of radiation (mainly in the vacuum ultraviolet). (auth)

Diagnostics

Refer also to abstract 20841.

20845 (AD-775791/7) CORRECTIONS TO WAVEGUIDE–PROBE MEASUREMENTS OF PLASMA TEMPERATURE. Singer,

A.; Minkowski, J. M. (Harry Diamond Labs., Washington, D. C. (USA)). May 1973. 27p. (HDL-TR-1620). NTIS $3.25.

Two major corrections are made to the Aro-Walsh determination of electron temperature of shock-heated plasma by means of microwave techniques. One correction concerns the reference level in the measurement of the plasma radiation temperature by means of the waveguide probe technique; it has the effect of consistently raising the experimentally determined electron temperature, yielding closer agreement between theory and experiment in the region of Mach 8.5 to 10.5. More importantly, the correction enhances the prominence of the region in which the results of this technique exceed the theoretical values, so that between Mach 7.9 and 8.5 the corrected waveguide probe results exhibit the same type of anomalous form as those obtained earlier by microwave horns. The second correction concerns Aro and Walsh's comparison of the electron plasma temperatures obtained by the waveguide probe with those obtained by microwave horns. (auth)

20846 (CLM-R-129) GENERAL PURPOSE CONTINUOUS OBSERVATION INFRA-RED VIEWER. Hamadto, S. A. (UKAEA Research Group, Abingdon. Culham Lab.). Jan 1974. 17p. Dep. NTIS (U. S. Sales Only) $4.00. UK £1.

A general purpose, cholesteric liquid crystal infra-red viewer has been constructed. The device, which is portable, cheap and simple to make and operate, has interchangeable screens and temperature bias facilities. It can detect power levels from a few tens of milliwatts to a few watts per cm^2. It affords a very convenient means for qualitative infra-red viewing, e.g., visualization of laser modes and interference patterns including Fabry-Perot fringes, optical alignment and determination of lens focal lengths at the infra-red. (auth)

20847 (IPP-IV-72) SOME ASPECTS OF PLASMA DIAGNOSTICS BY MEANS OF A DIAMAGNETIC COIL. Mayer, H. M. (Max-Planck-Institut fuer Plasmaphysik, Garching/Muenchen (F. R. Germany)). May 1974. 20p. Dep. NTIS (U. S. Sales Only) $4.00.

The response of a coil to diamagnetic pulses of exponential shape was calculated. The circuit considered consists of a coil which is terminated in a capacitive and resistive load and at the same time inductively coupled to a shield. Different geometries for compensation are discussed as well as the conditions which lead to integration of the original pulse. (auth)

20848 (JAERI-M-5400) EARLY SPECTROSCOPIC MEASUREMENTS IN JFT-2 PLASMA. Kasai, S.; Funahashi, A.; Inoue, K. (Japan Atomic Energy Research Inst., Tokyo). Sep 1973. 25p. (In Japanese). INIS.

The results are given that were obtained by visible and normal incidence vacuum ultraviolet spectroscopic measurements in JFT-2 discharge cleaning. Described are the ability of a visible and a normal incidence VUV monochromator, their arrangement for JFT-2 apparatus, spectral intensity measurements of neutral hydrogen H_β, carbon and oxygen atoms or ions, and photographic measurements in the vacuum ultraviolet region (1220 ~ 2000 Å). (auth)

20849 (JAERI-M-5437) NUMERICAL DATA PROCESSING OF THE ELECTROMAGNETIC SIGNALS OBTAINED IN TOKAMAK EXPERIMENTS BY MEANS OF THE METHOD OF LEAST SQUARES. Toi, Kazuo; Takeda, T. (Japan Atomic Energy Research Inst., Tokyo). Oct 1973. 36p. INIS.

A method of processing the data obtained from electromagnetic measurements in tokamak experiments was studied. In analysis of the digitized data, it is necessary to smooth the data. It is indispensable especially when numerical differentiation is required to process the time series consisting of the digitized data. The method of least squares is used for the purpose. The procedure of its application is also described. (auth)

20850 (JUL-1074-RG) NEUTRONIC MEASUREMENTS IN A DENSE PLASMA FOCUS. Cloth, P. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Reaktorentwicklung). May 1974. 71p. (In German). Dep. NTIS (US Sales Only) $6.75.

Thesis. Submitted to Technische Hochschule, Aachen (West Germany).

The development of a special plasma diagnostic method by means of fusion reaction neutrons is presented. Neutronic measurements to investigate the properties of the fusion plasma in a coaxial discharge gun, the so called dense plasma focus, were performed on the Jülich DPF machine, which has the following specifications: 25 kJ stored energy at 40 kV, 3 cm length of coaxial electrodes with 6 cm diameter of inner electrode (anode) and 11 cm of outer electrode. The total neutron yield is about 5×10^9 per discharge within 120 to 300 ns duration time at a working pressure of 0.5 to 3 torr D_2. The results of neutron spectrum measurements indicate the presence of high energy deuterons of at least 300 keV moving predominantly in the axial direction. Neutrons produced by fusion reactions of deuterium and ^7Li were observed, that show once more the presence of ions with energies above 300 keV to at least 1 MeV. By shadow bar technique it was found that the origin of the neutrons is confined to a cone, which extends from the anode to the lid of the discharge vessel; this suggests that deuterons get accelerated near the anode within the plasma column and traverse through the neutral gas freely. The fusion reactions have been detected all along the flight path of the deuterons up to a distance of 126 cm from the anode. Time resolved measurements of the neutron production show dependence of the emission time on the axial dimensions of the vessel. The results contradict the models of the dense plasma focus assuming production of neutrons by a confined plasma. (auth)

20851 (LBL-2470) HIGH-FREQUENCY STARK EFFECT AND ITS APPLICATION TO PLASMA DIAGNOSTICS. Hicks, W. W. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Dec 1973. Contract W-7405-eng-48. 174p. Dep. NTIS $11.75.

Thesis.

A theoretical and experimental study is presented of the high-frequency Stark effect of hydrogen and helium spectral lines. The theory starts from Schroedinger's equation for an atom in a monochromatic high-frequency electric field and a static magnetic field, and following a method due to Autler and Townes, reduces the problem to an equivalent problem of diagonalizing a matrix equation. The general solution of this matrix equation is discussed in some detail, the photon emission spectrum is calculated for the general case and for typical cases of hydrogen-like and helium-like spectral lines, and a physical interpretation of this solution in terms of multi-quantum transitions is developed. Calculated profiles of several spectral lines of both hydrogen and helium for a variety of electric field parameters are presented. For simplicity, all calculations are performed for a magnetic field equal to zero; however, the effect of (1) a dc electric field perpendicular to the high-frequency electric field, and (2) fine-structure splitting on the calculated profiles is considered for the first two hydrogen Balmer lines H_α and H_β. (auth)

20852 (LRP-82/74) PLASMA WAVE EXPERIMENT: A PRESENTATION OF THE DEVICE AND FIRST EXPERIMENTAL RESULTS. Bitter, M.; Paris, P. J. (Ecole Polytechnique Federale, Lausanne (Switzerland)). May 1974. 30p. Dep. NTIS (US Sales Only) $4.50.

A double humped electron velocity distribution is presented, which is produced by secondary emission of electrons from a fine meshed grid. The distribution can be easily modified by varying the grid potential. Preliminary investigation of the noise spectrum shows that plasma modes of well defined frequencies and wavelengths are driven unstable. (auth)

20853 ION CURRENT DENSITY ON THE SURFACE OF A SPHERICAL PROBE IN A FLOWING HIGH PRESSURE PLASMA. MacLatchy, C. S.; Budgel, P. C.; Miner, J. R. (Acadia Univ., Wolfville, Nova Scotia). Can. J. Phys.; 52: No. 12, 1057–1062(15 Jun 1974).

The positive ion current density on the surface of a spherical probe immersed in a flowing flame plasma was measured under thin sheath conditions. The hydrodynamic Reynolds number ranged from 96 to 720. No pronounced real fluid effects were observed in the current density although the probe is observed by Schlieren photography to exhibit boundary layer separation and wake formation. In spite of the real fluid behavior of the plasma fluid, the thin sheath theory describes the current density distribution on the probe surface very effectively. This is attributed to the formation and entrainment of a shielding layer of fluid, voided of charge during its passage through the sheath. (auth)

20854 MEASUREMENT OF THE MAGNETIC FIELD IN THE FLOW OF IONIZED MEDIA. Zaitsev, A. A. Meas. Tech. (USSR) (Engl. Transl.); 17: No. 2, 251-253(Feb 1974).

Translated from Izmer. Tekh.; 17: No. 2, 56-58(Feb 1974).

The measurement device consists of linear rods composed of individual ceramic cubes, which are inserted in nonmagnetic square tubes equidistant from the narrower walls. The tubes are arranged with the assigned orientations inside and outside the plasma flux so that they constitute a single hermetically sealed main, which emerges from the vacuum chamber. At its ends, there are tanks with valves, which contain a coolant. The operation of the system and some results are described. (MOW)

Kinetics (General)

20855 (AD-776003/6) PRODUCTION, CONTROL, AND UTILIZATION OF EXTREMELY HIGH DENSITY RELATIVISTIC

STREAMS. Final Report. Bennett, W. H. (North Carolina State Univ., Raleigh (USA). Dept. of Physics). 31 Dec 1973. 15p. (AFOSR-TR-74-0351). NTIS $3.00.

The project is concerned with the study of beam dynamics for electron beams above 10,000 amperes and above 1,000,000 volts, and primarily for beams above 100,000 amperes and above 10,000,000 volts. The objective is to develop methods for producing extremely intense pinch effects which will draw the beam down to diameters of the order of $\frac{1}{10}$ millimeter. Methods have been developed for injecting the beam into already formed linear pinched discharges and these studies are continuing to include the use of tapered pinch discharges. (auth)

20856 (EUR-4910) TABLES OF THERMODYNAMIC PROPERTIES OF ALKALI METAL PLASMAS IN THE TEMPERATURE RANGE 298.15–10,000°K AND THE PRESSURE RANGE 10^{-5}–10 ATM. Reiter, F. W.; Airola, J. (Commission of the European Communities, Brussels (Belgium)). 1972. 134p. INIS.

Tables of thermodynamic functions of alkali metal plasmas and their components, diatomic molecules, atoms, simply charged ions and electrons, in an ideal gas state are given in the temperature range 298.15 to 10,000°K and the pressure range 10^{-5} to 10 atm. The following functions are presented: Gibbs function, enthalpy, entropy, heat capacity at constant pressure, equilibrium constants of dissociation and ionization and molar fractions of the components of the plasmas. (INIS)

20857 (IPPJ-T-15) COAXIAL MARX GENERATOR FOR PRODUCING INTENSE RELATIVISTIC ELECTRON BEAMS. Kubota, Y.; Kawasaki, S.; Miyahara, A.; Saad, H. M. M. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Sep 1973. 8p. INIS.

A 600 kV Marx generator installed in a completely coaxial form was developed. The structure reduces the internal inductance down to about 80 nH and hence makes it possible to produce high intensity relativistic electron beams of several kA when applied to a field emission type electron gun. The system has a remarkably compact size of the full length 1400 mm and the diameter 250 mm. The rise time of the output voltage pulse is less than 10 nsec. (auth)

20858 CROSS SECTION FOR FORMATION OF N_2^{++} BY ELECTRON IMPACT IN N_2 AT 70 eV ELECTRON ENERGY. Maerk, T. D. (Univ., Innsbruck). Acta Phys. Austr.; 37: No. 4, 381-384(1973).

Double ionization of N_2 by electron impact was studied under various conditions (gas pressure, electron current and drawing-out field) in the ion source of a double focusing Varian MAT mass spectrometer CH5. The cross section for ionization by 70 electron volts through process $N_2 + e^- \rightarrow N_2^{++} 3e^-$ was found to be $q_{2+} = (1.48 \pm 0.22) \cdot 10^{-18}$ cm^2. (auth)

Kinetics (Experimental)

20859 (AD-776014/3) VORTEX STRUCTURES FOR THERMONUCLEAR POWER. Final Report. Wells, D. R. (Miami Univ., Coral Gables, Fla. (USA). Dept. of Physics). Feb 1974. 9p. (AFOSR-TR-74-0350). NTIS $3.00.

The high-density plasma group studied the hot plasma produced when two plasmoids, each generated by a conical theta pinch, collide in the presence of a mirror magnetic field. Diagnostic facilities are described. Construction of Trisops III with secondary compression mirrors is complete. (auth)

20860 PLASMA POLARIZATION SHIFTS OF He II RESONANCE LINES. Goto, T.; Burgess, D. D. (Imperial Coll. of Science and Tech., London). J. Phys., B (London); 7: No. 7, 857-864(11 May 1974).

Eight members of the He II resonance series were studied photographically at electron densities around 1.4×10^{17} cm^{-3} in a reproducible Z-pinch plasma. The results show that small shifts to shorter wavelength occur although the magnitudes are smaller than 0.03 Å even for the 9s-1p transition (for which the largest shift is expected theoretically). The measured shifts are compared with several theories proposed previously. (auth)

Kinetics (Theoretical)

20861 (EUR-CEA-FC-691) STATISTICAL MECHANICS OF NONUNIFORM SYSTEMS SUBJECTED TO AN ARBITRARY AND TIME DEPENDENT EXTERNAL FIELD. Dynamics of Nonkinetic States and the Superkinetic Equation. Application to Strong Plasma Turbulence. Balescu, R.; Misguich, J. H. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Groupe de Recherches sur la Fusion Controlee; CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee). May 1973. 218p. (In French). Dep. NTIS (US Sales Only) $14.00.

The separation of the distribution function of a system of N interacting particles into its two orthogonal projections in two invariant sub-spaces leads to the confirmation that the kinetic equation arises exactly from the kinetic components. The two orthogonal projections obey two completely decoupled equations as a result of the existence of two totally independent systems of sub-dynamics. Under normal experimental conditions, the non-kinetic component is zero for all observation times. The super-kinetic equation, P(t)f(t), proves to be particularly adequate for studying strong turbulence in plasmas: the external field is thus treated as a stochastic field having an average part and a fluctuating part. The changes occurring in the plasma in the presence of the fluctuating external field describe the turbulent behavior of the system. The asymptotic limit of the average equations is studied using the stochastic correlation subdynamics. A renormalization of the stochastic treatment enables an analogue of the Kraichnan model equation to be deduced as a first approximation. The quasi-linear stochastic approximation is established as a special case, both the superkinetic equation and its particular cases (Vlasov turbulent equation and those of Landau and Balescu–Lenard) being considered. In the case of a Vlasov plasma, the turbulent equation represents an analogue of the Weinstock equation. The quasi-linear stochastic approximation is an analogue of the Dupree treatment. (FR)

20862 (EUR-CEA-FC-718) KINETIC EQUATIONS FOR PLASMAS SUBMITTED TO A STRONG TIME-DEPENDENT EXTERNAL FIELD. IV. Renormalized Stochastic Treatment and Kraichnan Model Equation for Turbulence. Balescu, R.; Misguich, J. H. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Groupe de Recherches sur la Fusion Controlee; CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee). Dec 1973. 15p. Dep. NTIS (US Sales Only) $4.00.

The stochastic treatment developed in the preceding paper (Balescu, R.; Misguich, J. H. EUR-CEA-FC-717) for the general kinetic equation is renormalized here in such a way that the lowest order approximation yields to the analog of the Kraichnan model equation for fluid turbulence. (FR)

20863 (IPP-6/124) CURRENT FILAMENTATION IN PARALLEL FIELD TURBULENT PLASMAS. Biskamp, D.; Horton, W. (Max-Planck-Institut fuer Plasmaphysik, Garching/Muenchen (F. R. Germany)). Mar 1974. 24p. Dep. NTIS (U. S. Sales Only) $4.25.

Observing that the inverse temperature dependence of the anomalous resistivity of an electrostatically turbulent plasma suggests the possibility of current filamentation. The conditions for the occurrence of instabilities producing current filaments and current sheets in the high frequency domain ($\omega \gg \omega_{ci}$) of a parallel current driven turbulent plasma were studied. The effect of such a current filament at high densities ($\omega_{pe} > \omega_{ce}$) is shown to produce a perpendicular acceleration of the electrons which, under conditions where sufficient development of the filament occurs, creates cross-field ion acoustic turbulence. The presence of cross-field ion-acoustic turbulence, which in electrostatic simulation is observed to produce substantial heating, would substantially reduce the existing discrepancies between the parallel turbulent experiments and the corresponding electrostatic simulation. (auth)

20864 (IPP-III-12) ENERGY DISTRIBUTION OF ELECTRONS IN A PROTON–ELECTRON PLASMA WITH DENSITIES HIGHER THAN THE SOLID-STATE DENSITY. Wulff, H. (Max-Planck-Institut fuer Plasmaphysik, Garching/Muenchen (F. R. Germany)). May 1974. 20p. (In German). Dep. NTIS (US Sales Only) $4.00.

This paper proves that Fermi electrons have to be bound, which has hitherto gone unnoticed. The distinction between bound and free electrons valid for low-density plasmas is extended to high densities and a new energy distribution function for the electrons is given. It is found that for plasmas in which a Bohr sphere defined by a_B^3 (a_B = Bohr radius) contains more than one electron the Pauli principle is incompatible with the virial theorem. (auth)

20865 (JINR-P9-7970) MODELING OF DECELERATION OF RELATIVISTIC ELECTRON BEAM IN DENSE PLASMA. Bogolubskii, I. L. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1974. 15p. (In Russian). Dep. NTIS (U. S. Sales Only) $4.00.

Deceleration of relativistic electron beams in dense plasma was studied analytically and via computer simulations. The

self-similarity solutions were obtained and examined. The factors are pointed out which can lead to multispeed longitudinal motions in short duration beams. (auth)

20866 HIGH FREQUENCY PROPERTIES OF BOUNDED PLASMA. Vandenplas, P.; Messian, A. (Plasma Physics Lab., Brussels). Ukr. Fiz. Zh. (Russ. Ed.); 19: No. 5, 707-727(May 1974). (In Russian).

A review based on research performed at The Plasma Physics Laboratory of the Royal School in Brussels (Belgium) is presented. Linear resonance properties of bounded electron plasmas and their application to plasma diagnostics and antenna engineering are described. The phenomenon of plasma confinement by high-frequency resonance fields is considered and it is shown that this interesting phenomenon may be explained on the basis of the theory of the bounded plasma resonance properties. Absorption and resonance properties of the magnetized plasma column are studied within the range of magnetoionic resonance, i.e., in the range where both hot ions and hot electrons are of essential significance. In this range there are some absorption bands and a series of plasma resonances which are connected with the temperature of plasma and its bounded dimensions and are displayed at frequencies differing from characteristic frequencies of cold unbounded plasma. (auth)

20867 THEORETICAL FEATURES OF ANOMALOUS RESISTIVITY IN A TURBULENT PLASMA CONFINED IN A STRONG MAGNETIC FIELD. Dobrowolny, M.; Santini, F. Nuovo Cim., 22B: No. 2, 181-200(11 Aug 1974).

The problem of anomalous resistivity observed in plasmas confined in a strong magnetic field is discussed with regard to the low and high electric-field regimes. For low applied electric field and $T_e > T_i$ the effect of a turbulent spectrum of ion acoustic waves is investigated. With respect to previous treatments nonlinear effects such as broadening of the resonances between particles and waves and correlations among the waves are taken into consideration. Due to these effects a higher resistivity enhancement is found than from conventional theories of ion acoustic turbulence, which however is still low with respect to that observed in the experiments. Possible explanations are suggested. In the high-electric-field regime the possibility is discussed of the presence of a second spectrum of electron plasma waves. The conditions are given for which a decay of the latter waves into ion waves can explain the observed behavior of the anomalous resistivity. (auth)

20868 HIGH-TEMPERATURE STATE OF A PLASMA IN A POWERFUL MICROWAVE DISCHARGE. Asinovskii, E. I.; Batenin, V. M. (Inst. of High Temperatures, Moscow). High Temp. (USSR) (Engl. Transl.); 11: No. 2, 357-359(1973).

Translated from Teplofiz. Vys. Temp.; 11: No. 2, 407-409 (1973).

The possible mechanism of formation of a high-temperature state of a plasma with $n'_e \approx 10^{18}$ cm^{-3}, $T_e \approx 10^6$°K in the axial zone of a high-frequency high-pressure discharge in hydrogen and deuterium, and its existence in contact with a surrounding cold plasma with $n''_e \approx 10^{14}$ cm^{-3} and $T''_0 \approx 10^4$°K are studied. In order to do this one considers the heating of the electrons that form during the initial breakdown initiated by the introduction in a resonator of an antenna. Excitation losses were neglected. The given equation of energy balance of the electron gas must be supplemented by the ionization equation, the statement and investigation of which in the general case of a spatially inhomogeneous plasma have definite difficulties. However, taking into account the smallness of the characteristic time of electron heating (10^{-8} sec) in comparison with the time of breakdown, the latter agreeing in order of magnitude with the time of equalization of pressure in the discharge zone (10^{-6} sec), one can easily analyze the limiting case in which the electron density during electron heating is taken equal to the density in the final steady state. (MOW)

Production

20869 (UCRL-74937) PHYSICS OF LASER-IGNITED PELLETS: IMPLOSION HYDRODYNAMICS OF FERMI GASES AND CENTRAL THERMONUCLEAR BURN INITIATION. Wood, L.; Nuckolls, J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 30 Oct 1973. 11p. (CONF-731009-11). Dep. NTIS $4.00.

From annual plasma physics meeting of the American Physical Society; Philadelphia, Pennsylvania, USA (31 Oct 1973).

The basic physical processes operative in the laser-energized implosion and central ignition of fusion fuel pellets are considered with emphasis on those aspects which determine the energy efficiency of laser-induced thermonuclear microexplosion. The energy efficiency of laser-energized matter compression which is subject to generalization to the required degree is derived. (MOW)

20870 X-RAY EMISSION AND IONIZATION DYNAMICS OF LASER PRODUCED PLASMAS. Bristow, T. C. Rochester, NY; University of Rochester (1974). 146p. University Microfilms Order No. 74-14,384.

Thesis (Ph. D.).

The time history of conversion of input laser radiation to output soft x-rays from an oxygen-doped, spherical, laser produced plasma is calculated. Included is a calculation using a series of rate equations to describe the ionization dynamics of the impurity ions. The enhanced absorption due to the impurities of oxygen and argon is calculated, and a comparison made with the extra radiation from the impurities. Experimental measurements show, in some cases, an electron temperature between 800 eV and 1.2 keV with a Maxwellian velocity distribution of electrons. These measurements agree favorably with the results of the numerical program. For the non-Maxwellian cases, a two temperature calculation yields temperatures between 600 eV and 4 keV, in good agreement with the experimental results. There is no evidence of an appreciable flux of hard x-rays from these experiments. The predicted fast risetime ($<10^{-11}$ seconds) of the calculated line spectra suggests a method of producing stimulated emission in the soft x-ray region of the spectrum. Electron collisional excitation of a heavy impurity, in a light element laser plasma, leads to the possibility of producing a population inversion in the region of 100 Å. In particular, a gain of 76-630 cm^{-1} is calculated for the 3p-2s transition of the helium-like ion, O VII. (Diss. Abstr. Int., B)

20871 IDENTIFICATION OF TRANSITIONS FROM DOUBLY EXCITED LEVELS OF LITHIUM-LIKE Ti AND V IONS CONTAINED IN A LASER PLASMA. Aglitskii, E. V.; Boiko, V. A.; Zakharov, S. M.; Pikuz, S. A.; Faenov, A. Ya. (Lebedev Inst. of Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 19: No. 1, 8-10(5 Jan 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 19: No. 1, 16-18(5 Jan 1974).

Results are presented of observation of the helium-like ions Ti-XXI and V-XXII (with ionization potentials 6.250 and 6.825 keV, respectively). Identification of transitions of the type $1s2pnl \rightarrow 1s^2nl$ of Li-like Ti-XX and V-XXI (altogether 19 lines) is also reported (measurement accuracy 0.0005 Å). (auth)

Stability

20872 (LRP-80/74) PARAMETRIC INSTABILITIES OF ORDINARY AND HYBRID WAVES. Nguyen The Hung. (Ecole Polytechnique Federale, Lausanne (Switzerland)). May 1974. 18p. Dep. NTIS (US Sales Only) $4.00.

Coupled equations for ordinary and hybrid waves, propagating perpendicular to a static magnetic field, are derived within the fluid approximation. It is shown that a large amplitude ordinary wave is subject to a decay instability as well as a modulational instability. The latter corresponds to a modulation of the pump amplitude, and the excitation of a long wavelength hybrid wave. Characteristic quantities, such as the threshold intensity and the maximum growth rate, are calculated for various cases. In the limit of a vanishing magnetic field, the results for stimulated Raman and Brillouin scattering are recovered. (auth)

20873 (UCRL-51591) NUMERICAL STUDIES OF RESISTIVE INSTABILITIES IN DIFFUSE PINCHES. Dibiase, J. A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). May 1974. Contract W-7405-eng-48. 242p. Dep. NTIS $15.25.

Thesis.

A hydromagnetic model was developed to study resistive instabilities in cylindrical geometry, and the model is applied to study specific diffuse pinch configurations. The MHD equations include the effects of compressibility, finite resistivity, viscosity, and thermal conductivity. The plasma equilibrium configuration is assumed known and is specified by $B_{\theta 0}(r)$, $B_{z0}(r)$, $\eta_0(r)$, $\rho_0(r)$, $T_0(r)$ and these functions can be chosen to describe a particular experiment. The model can be applied to study both the MHD and resistive instability of a wide class of equilibrium configurations in cylindrical geometry. (MOW)

20874 NONLINEAR THEORY OF THE COLLISIONAL DRIFT WAVE INSTABILITY. Monticello, D. A. Rochester, NY; University of Rochester (1974). 106p. University Microfilms Order No. 74-14,409.

Thesis (Ph. D.).

The saturation amplitude of unstable collisional drift waves is studied. These waves are driven unstable by the presence of a density gradient in a fully ionized, magnetically confined plasma.

Two-fluid equations, which include ion inertia and viscosity, electron resistivity and electron temperature variation, are used to describe the plasma. Using the method of Simon, a nonlinear analysis of these governing equations is performed to determine the limiting amplitude of the linearly unstable waves. A comparison with drift wave experiments, performed on Q-machines, is made. (Diss. Abstr. Int., B)

20875 CONTRIBUTION TO THE NONLINEAR THEORY OF CYCLOTRON INSTABILITY. Lominadze, D. G.; Onishchenko, I. N.; Panchenko, I. P.; Shevchenko, V. I. (Physical-Technical Inst., Kiev). JETP Lett. (USSR) (Engl. Transl.); 19: No. 3, 107-109(5 Feb 1974).

Translated from Zh. Eksp. Teor. Fiz.; Pis'ma Red.; 19: No. 3, 172-175(5 Feb 1974).

Frequency simulation methods are used to investigate the non-linear dynamics of the cyclotron instability that sets in in the presence of a current flowing in a plasma in a direction perpendicular to the magnetic field. It is shown that ion capture leads to stabilization of the instability. The maximum electric-field amplitude of the excited wave is determined. (auth)

20876 OBSERVATION OF MAGNETIC-DRIFT INSTABILITY IN A SYSTEM WITH LARGE β. Ryzhov, N. M.; Sizonenko, V. L.; Suprunenko, V. A.; Sukhomlin, E. A. (Physical-Technical Inst., Kiev). JETP Lett. (USSR) (Engl. Transl.); 19: No. 3, 94-95(5 Feb 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 19: No. 2, 153-155(5 Feb 1973).

The low-frequency magnetic-drift instability in a θ-pinch plasma with $\beta \sim 1$ was studied. Its appearance is connected with the onset of the mechanism of thermalization of the accelerated-electron energy. The oscillation amplitude is comparable with the magnitude of the main magnetic field. (auth)

20877 MAGNETICALLY INDUCED INSTABILITY IN AN ARGON PLASMA. Hardy, R. H. S. Edmonton, Alberta; Univ. of Alberta (1971). 166p.

Thesis.

Observations of a highly structured discharge and current instability in unseeded, shock heated argon flowing through a region of large transverse magnetic field are presented and analyzed. The experimental results are related to an extension of the theory of ionization (electrothermal) instability in partially ionized gases in which the presence of multiply charged ions is taken into account. A critical magnetic field for instability onset is predicted. The growth rate and the angular dependence of the growth rate are calculated and compared with observations. An enhanced interaction between the current discharge and the plasma flow is observed. The magnitude of the interaction is compared with the magnitude of the Hall parameter in the plasma. A rotation of the current filaments to form a helical structure is observed. The formation of this structure is predicted by the use of a simple minimum energy consideration. (auth)

Thermonuclear Engineering and Equipment

Refer also to abstract 22503.

20878 (AEC-tr-7563) REPORT OF THE TECHNICAL SUBCOMMITTEE NUCLEAR FUSION RESEARCH AND DEVELOPMENT CONFERENCE. (Japan Atomic Energy Research Inst., Tokyo). 11 Nov 1973. Translation of Japanese Report. 81p. Dep. NTIS $7.25.

The directions for research and development during 1975 through 1979 are outlined for the following: (1) conditions for attaining critical plasmas, and (2) nuclear fusion core engineering technology and nuclear fusion reactor engineering technology needed to construct an experimental nuclear fusion power reactor. Deliberations have been conducted on the content and scale of this research and development. (MOW)

20879 (AED-Conf-74-095-001) DESIGN OF A PULSED DEUTERIUM LITHIUM NUCLEAR REACTOR. Fischer, A. G. (Dortmund Univ. (F. R. Germany). Abt. Elektrotechnik). 1974. 5p. INIS.

From reactor meeting; Berlin, F. R. Germany (2 Apr 1974). 7 figs. With abstract.

This is a proposal for a reactor that burns hydrogen bomb material 6-lithium deuterotritide to helium in successive micro-explosions which are ignited electrically and enclosed by this same molten material, and that permits the conversion of the reaction heat into useful electrical power. A specially constructed capacitor of low inductance is discharged via a thermally preformed highly conducting path through a mass of the molten salt $^6LiD_{1-x}T_x$ $(0 < x < 1)$. In the resulting dense, hot plasma filament, primary nucleons are formed in the sausage-instabilities by D–T fusion. They start Jetter-McNally-type suprathermal fission–fusion avalanches which propagate towards the cathode and are confined by the azimuthal magnetic field of the current. Neutrons that escape sideways are utilized to breed tritium in the surrounding liquid Li_2DT blanket. At the end of the current pulse and magnetic confinement, the plasma filament disintegrates and the nuclear fire is extinguished in the surrounding cold matter. The energy set free is insufficient to convert the blanket into a hot plasma in which the chains could propagate and escalate. The liquid blanket also serves as a neutron radiation shield, and the shock wave is attenuated in it by a curtain of rising deuterium bubbles. The heat shock is buffered by partial melting of the external Li_2DT crust. The reaction heat is conducted by the liquid metal of the external cooling jacket to the heat exchanger of the associated turbo-generator. Every few seconds, a new pulse can take place. The design is based on known effects and is the most practical so far. A simple possible test is described. (orig.)

20880 (AGARD-CP-104, pp 4.1-4.7) USE OF SUPERCONDUCTORS FOR PULSED EXPERIMENTS IN PLASMA PHYSICS. Martinelli, A. P. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Dec 1972.

From 39th meeting of the AGARD propulsion and energetics panel; Colorado Springs, Colorado, USA (12 Jun 1972).

Superconducting magnets are being increasingly used in plasma experiments and will be an essential component of possible future thermonuclear reactors. Many magnetic configurations for plasma experiments and for reactors as well consist of a stationary magnetic field produced by a superconducting magnet system on which a time dependent magnetic field is superposed. Examples are the sustained field configuration in theta pinch experiments, stellarators during switching on of the helical field, and tokamaks and stellarators during the field pulse used for ohmic heating of the plasma. The effect of pulsed magnetic fields (rise time 5 to 500 usec, amplitude 0 to 10 kOe) on superconducting coils is studied in a number of nonstabilized single-core and multicore current carrying Nb-Ti superconductors in the form of short samples and small bifilar or inductive coils. Experimental results and calculation methods already reported are complemented and extended. The use and limitation of superconductors in pulsed magnetic configurations as field generating or field shielding coils are discussed. (auth)

20881 (COO-2007-38) ADVANCED METHODS FOR NUCLEAR REACTOR-GAS LASER COUPLING. Technical Progress Report, January 1–August 31, 1973. Miley, G. H.; Verdeyen, J. T. (Illinois Univ., Urbana (USA)). 1973. Contract AT(11-1)-2007. 22p. Dep. NTIS $4.25.

During this abbreviated contract period, the following work was undertaken and/or completed: (a) radiation enhancement studies of a pulsed *He–Ne* laser in the pressure range of 10 to 80 torr operating on both 3.39 and 1.15 μ; (b) radiation initiation and enhancement of chemical lasers; (c) optical spectra measurements were extended to high-pressure helium mixtures irradiated by alpha particles; (d) bench tests of a pulsed $Ne–O_2$ laser were essentially completed; (e) bench tests of probe methods for measuring electron energy distribution in lasers with an external ionization source were initiated; and (f) enhancement of CO_2 laser at low levels of irradiation. Each of these areas is described in some detail. (auth)

20882 (COO-2218-13) COMPRESSION-EXPANSION CYCLES FOR TOROIDAL FUSION REACTORS. Miley, G. H. (Illinois Univ., Urbana (USA)). 1974. Contract AT(11-1)-2218. 16p. (CONF-740402-17). Dep. NTIS $4.00.

From topical meeting on technology of controlled nuclear fusion; San Diego, California, USA (16 Apr 1974).

The potential use of compression-expansion cycles to directly recover energy from fusion reactors is considered with emphasis on low-β toroidal devices. Three different cycles are analyzed primarily differing by conditions during the burn. The Type-S cycle employs a constant pressure burn, Type-PE uses a programmed expansion to maintain a constant temperature during the burn, while the Type-PC cycle uses a programmed compression to provide energy clamping of superthermal ions in a two-component plasma. Efficiencies and various auxiliary relations are considered for the different cycles. (auth)

20883 (COO-2218-18) ADVANCED ENERGY CONVERSION FOR FUSION REACTORS WITH A SUBTASK ON CHARGE-EXCHANGE EFFECTS DURING NEUTRAL BEAM INJECTION. Technical Progress Report, August 31, 1973–September 1, 1974.

Miley, G. H. (Illinois Univ., Urbana (USA)). 1974. Contract AT(11-1)-2218. 103p. Dep. NTIS $8.25.

Research studies are discussed for the following: (1) review of potential advanced fuel cycles, (2) energy-balance calculations for high-temperature plasmas, and (3) evaluation of two-component reactors for use with both D-T and advanced fuels. Some work on charge-exchange effects during neutral beam injection is also reported. (MOW)

20884 (EUR-CEA-FC-725) ENERGY STORABLE IN SUPERCONDUCTING RESONANT CAVITIES. Reuss, J. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Groupe de Recherches sur la Fusion Controlee; CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee). Jan 1974. 26p. (In French). Dep. NTIS (US Sales Only) $4.50.

Superconducting resonant cavities can have overvoltage coefficients as high as 10^{11}. Up to the present time, however, the amount of energy that can be stored in this way is small, because of the fact that the hf magnetic induction along the walls cannot exceed about 0.1T without a considerable drop in Q-value occurring. Nevertheless, no theoretical limit has been clearly established for the maximum hf induction amplitude. It is possible that new superconducting materials will be developed permitting the storage of larger amounts of energy. For a given amount of stored energy, the power of the supply generator varies inversely with the level of helium consumption. If a large increase in magnetic induction could be achieved, these two factors might constitute technological and economic limitations to the exploitation of this phenomenon. Although the problems associated with the use of such stored energy are only briefly mentioned, they may be considerable. (FR)

20885 (IPP-4/114) HIGH-VOLTAGE PULSE GENERATOR. Klement, G.; Wedler, H. (Max-Planck-Institut fuer Plasmaphysik, Garching/Muenchen (F. R. Germany)). Mar 1974. 67p. (In German). Dep. NTIS (U. S. Sales Only) $6.50.

The described generators were developed as a standard series. The design was concerned with low inductance, but rather with simple construction and low price. For each of four different types of capacitors one-to-five-stage generators were developed and tested. The data of the individual types of generators are listed in table form and a few oscillograms for typical applications are presented. The jitter and delay as function of the charging voltage show the range of operation. The above information is completed by individual circuits. The components used, such as spark gaps, pulse transformer, shorting facilities etc. were also developed at IPP. The manufacturer's data and test results are presented in separate tables for the pulse cables and pulse capacitors. (auth)

20886 (IPP-4/117) THE MAGNETIC IRON-CORE MODEL AND STRAY FIELD MEASUREMENTS FOR PULSATOR I AND THEIR RELEVANCE TO JET. Gernhardt, J.; Herppich, G.; Werner, F. (Max-Planck-Institut fuer Plasmaphysik, Garching/Muenchen (F. R. Germany)). Feb 1974. 7p. (AED-CONF-74-162-001; IPP-3/11).

From workshop on the technical aspects of the JET-assembly; Culham, UK (28 Feb 1974).

Results of the measurements at the Pulsator I iron core magnetic model are compared with the stray field measurements at the original core. Special regard is given to the plasma simulation. Outlines for a JET model are presented. (GE)

20887 (IPPJ-T-16) MULTICHANNEL STORAGE CAPACITOR SYSTEM FOR PROCESSING OF FAST SIMULTANEOUS SIGNALS. Ogata, A. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Oct 1973. 13p. INIS.

A storage capacitor system is described which collects simultaneous signals in a very short sampling time, stores them in capacitors and gives them as an output slowly in a serial form. (auth)

20888 (JAERI-M-5433) DESIGN AND TEST OF THE DRIVING MECHANISM FOR A DYNAMIC LIMITER. Ohta, M.; Ohga, T.; Kunieda, S.; Yamamoto, M.; Hamano, N. (Japan Atomic Energy Research Inst., Tokyo). Oct 1973. 17p. (In Japanese). INIS.

A dynamic fast-acting removable limiter was installed in the JFT-2 in January 1973. The limiter was removed while or after the plasma is produced in order to study the diffusion process in a tokamak plasma. The design and tests of the driving mechanism of dynamic limiter are described. The dynamic limiter consists of two rail limiters, an air cylinder and its electromagnetic valves, driving gears, and bellows to maintain the vacuum. Rubber is placed around the bellows to absorb the vibration produced at the end of strokes. The dynamic limiter should be removed with an average velocity of 5 m/sec for the stroke of 10 cm, which is expected to be faster than the diffusion velocity of plasma. Tests of the driving mechanism have shown the final and average velocities to be about 9 m/sec and 5.2 m/sec, respectively, at a cylinder pressure of 10 kg/cm^2. The velocity reaches 5 m/sec at about 2 cm of travel, which means that the average speed over 5 m/sec is attained in the last 8 cm of stroke. The delay time between trigger pulse and beginning of motion depends on the cylinder pressure and is about 50 msec at a pressure of 10 kg/cm^2. The jitter in delay time is less than 1 msec, much shorter than the confinement time expected with JFT-2. By using the dynamic limiter, a new information on the diffusion process is expected in the near future. (auth)

20889 (LA-5604-MS) ABLATION STABILITY OF LASER-DRIVEN IMPLOSIONS. Henderson, D. B.; McCrory, R. L.; Morse, R. L. (Los Alamos Scientific Lab., N. Mex. (USA)). Jun 1974. Contract W-7405-eng-36. 5p. Dep. NTIS $4.00.

The perturbation analysis of laser-driven implosions was examined showing the positive stability of the ablation surface. The opposite conclusion has been reported by others. Numerical results are reported from a more complete class of problems. The conclusions are supported by general physical arguments. (auth)

20890 (LA-5635-MS) SURVEY OF A 210-kJ DENSE PLASMA FOCUS (DPF 6). Freiwald, D. A.; Downing, J. N. (Los Alamos Scientific Lab., N. Mex. (USA)). Jun 1974. Contract W-7405-eng-36. 13p. Dep. NTIS $4.00.

An experimental survey has been done on a 212-kJ dense plasma focus machine (DPF-6) in order to obtain statistical data on its performance including optimization thereof. Several shots were taken for each of various combinations of charging voltages and fill gas pressure, with a total of several hundred shots, for a fixed system geometry. Reported here are voltage, current, focus x-ray pulse width, and x-ray and neutron measurements, from which intramachine scaling parameters are obtained. This survey, probably more complete than any heretofore reported for a DPF facility, may also be useful for interfacility comparisons, and comparison of various plasma focus theories. The effect of the presence of large copper probes near the focus plasma is briefly discussed in the Appendix. (auth)

20891 (LA-5640-MS) CTR BREAKEVEN INCLUDING ENERGY TRANSFER AND RECOVERY EFFICIENCIES. Freiwald, D. A.; Gerwin, R. A. (Los Alamos Scientific Lab., N. Mex. (USA)). Jun 1974. Contract W-7405-eng-36. 7p. Dep. NTIS $4.00.

Breakeven conditions for controlled thermonuclear reactions (CTR) are addressed. Simple but general equations are presented which include energy transfer (ϵ_i) and recovery (η_i) efficiencies for energies in various forms. A general equation for breakeven is developed, showing the sensitivity of the efficiency factors. Each experiment will have its own breakeven curve, depending on the η's and ϵ's. (auth)

20892 (LA-5641-MS) APPROXIMATE SPHERICAL BLAST THEORY AND LASER-INITIATED PELLET MICROEXPLOSIONS. Freiwald, D. A. (Los Alamos Scientific Lab., N. Mex. (USA)). Jun 1974. Contract W-7405-eng-36. 5p. Dep. NTIS $4.00.

Equations are presented which describe the shock speed and overpressure as a function of radius for strong spherical blasts in cases where the source mass is not negligible. Approximations similar to those used in the Taylor-Sedov approximate theory are employed. Sample calculations are presented for a laser-initiated 1-MJ (debris energy) pellet microexplosion and compared to Taylor-Sedov approximate theory solutions. (auth)

20893 (NP-20040) A SHORT COURSE IN FUSION POWER. (Princeton Univ., N. J. (USA). Plasma Physics Lab.). 1972. 372p. Dep. NTIS $10.60.

Lectures on the following are included: (1) problems in siting and ecology of electric power plants, (2) economics of a fusion power system, (3) introduction of fusion power into the network, (4) fusion and national energy, (5) introduction to plasma physics, (6) status and prospects for controlled fusion, (7) introduction to fusion power reactors, (8) plasma physics, (9) fusion reactors, (10) design of high-field, air-core magnets, (11) superconductivity as applied to fusion reactors, (12) injection, heating, and ignition, (13) extrapolation of experimental tokamaks to power reactors, (14) wall limitations and the divertor problem, (15) blanket neutronics, activation, fuel breeding, (16) chemical engineering problems in fusion reactor development, (17) selected problems of tritium management related to CTR, and (18) reality of the prospects of thermonuclear power. (MOW)

20894 (ORNL-TM-4575) FUSION CHAIN REACTOR PROSPECTS AND PROBLEMS. McNally, J. R. Jr. (Oak Ridge National Lab., Tenn. (USA)). Jul 1974. Contract W-7405-eng-26. 64p. Dep. NTIS $6.25.

Recent major developments in CTR research give support to the idea of developing a fusioning plasma in a magnetic mirror which is closed by the self-magnetic-field of a trapped ring current of ions (I-layer), with the electrons sustained at MeV energies principally by electron cyclotron heating (ECH). The viability of charged particle fusion chain reactions is thereby increased and sub-critical nuclear chain reaction burning of cheap ^{6}LiD nuclear fuel in a radiologically cleaner system may ensue. Reaction kinetics studies of D-^{3}He fueled plasmas in partially closed mirrors ($R = 10^4$) give MeV energies for the average energies of the light fusion reaction product ions which are the necessary catalysts or active chain centers for the propagation of such fusion chain reactions. In a closed magnetic mirror or I-layer the energetic charged reaction products may sustain both the I-layer configuration, as a result of nutational motion and burning conditions, and may also lead to the sub-critical start-up of supplemental linear or toroidal multiple mirror reactors in which the electron temperature is also sustained by ECH in small systems. Larger systems would be required for net power producers if such are feasible. Some of the numerous problem areas associated with this approach are discussed and these will require extensive research and development. (auth)

20895 (ORNL-TM-4647) REACTIVITY OF ADVANCED FUSION FUELS. McNally, J. R. Jr. (Oak Ridge National Lab., Tenn. (USA)). Jul 1974. Contract W-7405-eng-26. 25p. Dep. NTIS $4.25.

The advanced fusion fuels D·D and ^{6}Li·D offer significant advantages for future fusion reactors including the capability of pulsed or steady state burning in high β reactors (closed mirrors, θ-pinch, plasma focus) or inertially confined, high density systems. Some of the operational features of high β systems are presented in support of these prospects. (auth)

20896 (UCID-16564) RELATION OF THE MIRROR CONCEPT TO OTHER MAGNETIC APPROACHES TO FUSION POWER. Fowler, T. K. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 25 Jul 1974. Contract W-7405-eng-48. 14p. Dep. NTIS $4.00.

Injection and heating concepts for magnetic mirrors, toroidal theta pinches, and tokamaks are discussed. The power amplification factor Q is compared along with the beta ratio and engineering simplicity of the three approaches. (MOW)

20897 (UCRL-51606) CALCULATED INTENSITY THRESHOLD FOR THE MAINTENANCE OF LASER-SUPPORTED DETONATION WAVES WITH VARIOUS ELECTRON DENSITIES. Ferriter, N. M.; Winslow, A. M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 10 Jun 1974. Contract W-7405-eng-48. 15p. Dep. NTIS $4.00.

A one-dimensional intensity threshold for the maintenance of laser-supported detonation (LSD) waves is calculated based on the free electron density at the Chapman-Jouguet point. A free electron density equal to 7% of the critical electron density correlates well with available experimental threshold intensity measurements in air and with LASNEX calculations. Thresholds are calculated in air as a function of density. A minimum at about 2% of normal density is found for $\lambda = 10.6$ μm, due to the effect of molecular binding energy, but no minimum is found for $\lambda = 1.06$ μm. For a given wavelength, a maximum height is found above which LSD waves cannot be maintained. Results are also given for argon. For intensities sufficiently high above threshold, the existence of supercritical electron density at the Chapman-Jouguet point is predicted. (auth)

20898 (UCRL-51608) ELECTRON BEAM–DEUTERATED TARGET EXPERIMENT. Freeman, B. L. Jr. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 14 Jun 1974. Contract W-7405-eng-48. 125p. Dep. NTIS $9.25.

Thesis.

The Pulserad 422 electron beam facility at the Lawrence Livermore Laboratory was used to investigate the interaction of an intense electron beam with a deuterated target assembly. The performance of the apparatus, consisting of a deuterated polyethylene (CD_2) cathode tip, an insulated CD_2 disk with a tapered hole through its axis in the anode plane, and an insulated rear target of CD_2, was monitored with neutronic, optical, and electrical measurements. Open-shutter and image-converter photographs comprise the main optical measurements. The electrical characteristics observed were the voltage and current at various locations in the geometry along with microwave observations in the area between the front and rear targets. Neutronic information was obtained in the form of total yield from silver activation, fission foil track and sulfur activation methods, and time-resolved yield with time-of-flight oscillographs from scintillator-photomultiplier detectors. Average neutron total yields of $\sim 10^{10}$ n/pulse were obtained with the standard CD_2 target geometry, and a high-energy neutron group was reproducibly observed by time-of-flight when CD_2 had been used in the cathode tip, anode, and rear target. An energy assignment of 14 MeV for this peak would not be inconsistent with other data obtained. (auth)

20899 (UCRL-51610) MODULAR FISSION–FUSION HYBRID BLANKET. Hansborough, L. D.; Werner, R. W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Jul 1974. Contract W-7405-eng-48. 15p. Dep. NTIS $4.00.

A preliminary design is given of helium-cooled hybrid blanket of modular design proposed for a 1000-MW(e) Yin–Yang confinement mirror reactor. The modules are triangular prisms; the first wall of the assembled blanket is similar in shape to a geodesic sphere. The stainless-steel shell of each module encloses five helium-coolant tubes. The lithium within the modules is canned in niobium to reduce the handling problems and minimize the consequences of a helium leak. Tritium is recovered by permeation into evacuated niobium tubes. Liquid lithium is the heat-transfer coupler from the cans to the helium coolant tubes. Three fuel-region designs are proposed. Design A uses clad, solid-fuel wedges of uranium monocarbide or uranium mononitride held in place against the coolant tubes by tungsten springs; the wedges have a cover gas to enhance the heat transfer. Designs B and C employ spherical fuel pellets in niobium cans similar to those in the high-lithium region, with lithium acting as the heat-transfer agent to the coolant tubes. The Design B pellets are clad; the Design C pellets are not. Cladding adds about 10 vol % of neutronically unproductive material to the fuel region. Preliminary heat-transfer analyses for a 1-MW/m^2 first-wall flux indicate that the design is limited chiefly by the ability of the helium coolant to remove the heat conducted through the pipe walls in the fuel region. Approximately 9450 modules are needed for the proposed design. The calculated weight per module is about 386 kg, of which more than 90% is the weight of the uranium fuel. Because the fuel burnup rate is low, refueling probably would not be required oftener than once every five years. A refueling system is proposed that would permit the replacement of single modules. (auth)

20900 (UCRL-74487) FUTURE INTERNAL COMBUSTION ENGINE. Teller, E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 9 May 1972. 10p. (CONF-720558-3). Dep. NTIS $4.00.

From 7th international conference on quantum electronics; Montreal, Canada (8 May 1972).

The use of lasers to compress fusionable material is discussed in terms of laser energies and densities required for microexplosions to occur. Some problems during practical use of the microexplosions are discussed. It is suggested that space propulsion may be the best use for a system of this type. (MOW)

20901 (UCRL-74488) PROSPECTS FOR UNCONVENTIONAL APPROACHES TO CONTROLLED FUSION. Wood, L.; Nuckolls, J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 29 Dec 1971. 24p. (CONF-711203-3). Dep. NTIS $4.25.

From American Association for the Advancement of Science annual meeting; Philadelphia, Pennsylvania, USA (26 Dec 1971).

It is generally agreed that the effort to create thermonuclear fusion power reactors which will produce more electric power than they consume via conventional approaches will probably succeed sometime around 1980. The possibility that less conventional approaches, exploiting recent technological advances, may attain this goal more rapidly is considered. Four examples of such approaches are presented, ranging in degrees of unconventionality from magnetically confined, laser-heated plasmas to laser-initiated fusion microexplosions. It is noted that the intense Soviet-American competition in the fusion microexplosion field may be expected to produce a breakeven-level experiment in the next 24 months, and that net energy-producing systems may be confidently foreseen. Some of the implications of cheap, clean, inexhaustable electrical energy from fusion for various sectors of human endeavor are briefly surveyed, and the cost-benefit ratio of CTR research noted. (auth)

20902 (UCRL-74938) EXOTIC ETR FUELS: NON-THERMAL EFFECTS AND LASER FUSION APPLICATIONS. Weaver, T.; Zimmerman, G.; Wood, L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 30 Oct 1973. 13p. (CONF-731009-10). Dep. NTIS $4.00.

From annual plasma physics meeting of the American Physical Society; Philadelphia, Pennsylvania, USA (31 Oct 1973).

"Exotic" fusion fuel systems are defined as those that would not be subject to such difficulties as present fuel cycles. Ideally, such a fuel system would involve no neutron- or radionuclide-producing reactions; have cheap and inexhaustibly available re-

actants; output most of its energy as charged particles; and have a sufficiently high energy-generation rate to be usable in projected laser fusion or other CTR systems. The light elements were searched for such reactions and one new and promising candidate was found in the reaction: $p + {}^{11}B \rightarrow 3{}^{4}He + 8.68$ MeV (denoted below as $p^{11}B$). In certain modes of reactor operation, this reaction appears capable of substantially satisfying all of the above criteria. Other possibly interesting fuel combinations include: $p^{6}Li$, $d^{6}Li$, $p^{9}Be$, $d^{9}Be$, $p^{10}B$, and $p^{15}N$, though these suffer from relatively low reaction rates and in some cases substantial neutron and radionuclide production. These cycles are discussed. (MOW)

20903 (WASH-1295) STATUS AND OBJECTIVES OF TOKAMAK SYSTEMS FOR FUSION RESEARCH. (USAEC, Washington, D.C.). 1974. 111p. Dep. NTIS $8.75.

The following topics related to tokamak research are discussed: (1) configurational stability and optimization, (2) plasma transport and scaling laws, (3) heating, and (4) boundary effects. (MOW)

20904 MAGNETIC TRAP FOR CURRENTLESS PLASMA WITH ELLIPTIC MAGNETIC SURFACES–STELLARON (RING STELLARATOR). Danilkin, I. S.; Kovrizhnykh, L. M. (Lebedev Inst. of Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 19: No. 4, 119-121(20 Feb 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 19: No. 4, 193-197(20 Feb 1974).

A stellarator trap is proposed with elliptic magnetic surfaces with semiaxes a and b; this trap has transport coefficients smaller by a factor $(b/a)^2$ than traps with round cross section. At equivalent plasma volumes, this makes it possible to increase the confinement time by a factor (b/a), reducing by the same token the corresponding summary energy ignition threshold and the energy release in the thermonuclear reaction. Estimates of the transport coefficients are obtained within the framework of the so-called "neoclassical" model of collision diffusion. (auth)

20905 WAYS TOWARDS CONTROLLED FUSION. Wobig, H. (Max-Planck-Institut fuer Plasmaphysik, Garching/Muenchen (F.R. Germany)). Naturwissenschaften; 62: No. 3, 97-106(Mar 1974). (In German).

7 figs.; 4 tabs.; 52 refs.

This paper gives a general description of various approaches towards controlled thermonuclear fusion. The physical principles of the main lines: laser fusion, toroidal confinement and mirror machines are described. A summary of the latest experimental results is included. (GE)

20906 SELF-CONSISTENT FLUX SURFACES IN OHMICALLY HEATED STELLARATORS AND TOKAMAKS WITH HELICAL WINDINGS. Sestero, A. (CNEN–EURATOM, Frascati, Italy); Cenacchi, G.; Taroni, A. Lett. Nuovo Cim.; 10: No. 16, 723-725 (17 Aug 1974).

An asymptotic expansion scheme was used to calculate self-consistent surfaces in ohmically heated stellarators and tokamaks with helical windings. A few examples that were computed from the lowest-order theory are discussed. Rather large values of the rotational transform were considered, primarily in order to check the validity limits of the expansion procedure. (MOW)

Wave Phenomena

Refer also to abstract 20852.

20907 (CNAEM-R-109) BEAM–PLASMA INTERACTION AND PLASMA WAVES IN AN ELECTRON BEAM–PLASMA SYSTEM. Gultekin, E. (Cekmece Nuclear Research Center, Istanbul (Turkey)). 1973. 35p. INIS.

In an electron beam–plasma system the dispersion diagram of the plasma wave has been determined by means of an interferometer method. The relation between the phase velocity of the plasma instability and the beam velocity was measured. The plasma instability was studied as a function of different parameters. The plasma density was measured with a Langmuir probe and obtained from the dispersion characteristic of the plasma. The axial profile of the plasma temperature, plasma potential, and the density was also measured. (auth)

20908 (IPP-IV-71) FINITE TEMPERATURE EFFECTS ON THE LOWER-HYBRID DISPERSION CHARACTERISTICS. Puri, S.; Tutter, M. (Max-Planck-Institut fuer Plasmaphysik, Garching/Muenchen (F. R. Germany)). Apr 1974. 12p. Dep. NTIS (U. S. Sales Only) $4.00.

Computations using the full hot-plasma dielectric tensor show that the lower-hybrid wave may be effectively absorbed by electron resistivity even at the thermonuclear temperatures. There is no evidence of coupling to the cyclotron harmonic modes. (auth)

20909 OBSERVATIONS OF THE $k_{\parallel}$ WAVE SPECTRUM IN A PLASMA AROUND THE LOWER HYBRID RESONANCE. McDaniel, D. H. Austin, TX; University of Texas (1974). 147p. University Microfilms Order No. 74-14,734.

Thesis (Ph. D.).

A pulsed rf plasma experiment was constructed in order to study the behavior of the $k_{\parallel}$ spectrum of waves in a finite system around the lower hybrid resonance. The experiment consisted of a pyrex discharge tube 4 feet long and of 3 inch inside diameter. This tube was connected to a system for regulating pressure in the 0.5 to 1.0 micron range using deuterium gas. The pyrex tube was also connected to a vacuum system for flowing the gas through the system and which provided a base pressure of 2×10^{-7} torr. The discharge tube was mounted in a set of magnetic field coils which provided a semihomogeneous field which could be varied from 0.3 to 0.8 kG over a central region of 75 cm. Around the pyrex tube was an induction coil in the form of a three stage Stix coil with a wavelength of 48.8 cm. This coil was connected to a 40 kW rf transmitter operating at 20 MHz and which served the purpose of creating the plasma and launching the wave whose $k_{\parallel}$ spectrum was to be studied. It was found that the Faraday shield only slightly sharpened the Fourier spectrum in the plasma. Very good agreement was obtained between the experimental and the theoretical vacuum cases. This indicates that the experimental technique was reliable and one could have confidence in the spectra determined in the presence of the plasma. The comparison of the observed spectrum and the theoretical spectrum indicated: (1) that the structure of the individual modes as a function of plasma parameters indicates the existence of geometrical resonance in the region which the theory predicts but with much lower wave amplitude, and (2) that the radial density gradient decouples the spectra in the vacuum region and the low density plasma region from the higher density regions of the plasma. The homogeneous theory predicts that the $k_{\parallel}$ spectrum in the plasma can be quite different from the spectrum in vacuum. This is significant for any rf heating mechanism which depends on the parallel wavelength of the wave and indicates that further theoretical work should be done in order to be able to predict the effect the density gradient has on the $k_{\parallel}$ spectrum of waves launched by a geometric structure. (Diss. Abstr. Int., B)

20910 SELF DISTORTION OF A GAUSSIAN ELECTROMAGNETIC PULSE IN A PLASMA. Sodha, M. S.; Prasad, S. (Indian Inst. of Tech., New Delhi. Dept. of Physics); Tripathi, V. K. (Indian Inst. of Tech., New Delhi. School of Radar Studies). Appl. Phys.; 3: No. 3, 213-216(Mar 1974).

3 figs.; 4 refs.

On the basis of perturbation theory, the phenomenon of nonlinear self distortion of an electromagnetic pulse (Gaussian in time) in a collisional plasma was studied. The nonlinearity appears through the modulation of electron collision frequency by the power absorption from the wave. At moderate energies of the pulse, considerable distortion in the amplitude envelope was predicted. From the solutions of the momentum and energy balance equations, an expression for the nonlinear current density in the plasma was derived in the first-order perturbation approximation; the amplitude envelope of the pulse was taken to be Gaussian. Using this expression for the current density, the wave equation was solved for the electric vector in the WKB approximation. The resulting amplitude envelope of the pulse inside the plasma is considerably different from its initial profile. (GE)

20911 SELF-FOCUSING OF LANGMUIR OSCILLATIONS. Litvak, A. G.; Fraiman, G. M.; Yanakovskii, A. D. JETP Lett. (USSR) (Engl. Transl.); 19: No. 1, 13-16(5 Jan 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 19: No. 1, 23-28(5 Jan 1974).

Computer calculations and a qualitative analysis of the equations were used to investigate the character of nonstationary self-focusing of Langmuir oscillations of an isotropic plasma. The conditions under which self-focusing leads to effective plasmon energy dissipation are determined. (auth)

20912 SURFACE ABSORPTION COEFFICIENT AT OBLIQUE INCIDENCE OF A WAVE ON A MAGNETOACTIVE PLASMA. Benkhabib, F.; Kondratenko, A. N. (Leningrad State Univ.). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 17: No. 2, 283-286(1974). (In Russian).

Formulas are developed for determining the surface absorption coefficient for a magnetoactive plasma. (SJR)

20913 THEORY OF ELECTROMAGNETIC WAVE PROPAGATION IN ULTRARELATIVISTIC ANISOTROPIC PLASMA. Onish-

chenko, O. G. (Inst. of Cosmic Research, Moscow). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 17: No. 2, 287-289(1974). (In Russian).

The theory of electromagnetic wave propagation in anisotropic plasmas is developed mathematically. (SJR)

20914 NONLINEAR SECOND HARMONIC GENERATION IN BOUNDED COLD BEAM-HOT PLASMA SYSTEMS. Basu, B. N. (Regional Inst. of Tech., Jamshedpur, India). Indian J. Pure Appl. Phys.; 12: No. 1, 35-38(Jan 1974).

A kinetic theory was developed for studying the phenomenon of second harmonic generation taking place in a nonlinear bounded beam-plasma system. The solution of the space-charge wave equation, derived in this study, has predicted finite values of second harmonic current density at the maximum amplifiable frequency of the system ($\omega = \omega_{pp}$) and a half of this frequency ($\omega = \frac{1}{2}\omega_{pp}$), instead of what have been obtained as finite from calculations at these frequencies by a hydrodynamic method that neglected plasma temperature and finiteness of the system [Basu, B. N., Indian J. Pure Appl. Phys., 10 (1972), 64]. The relative values of finite peaks of the second harmonic current density depend critically on the distance from the input plane of the system. (auth)

ENGINEERING

Energy Conversion

Refer also to abstracts 20882, 21006, and 21523.

20915 (AGARD-CP-104, pp 10.1-10.9) LIGHTWEIGHT SUPERCONDUCTION MAGNET FOR AIRBORNE MHD GENERATORS. Atherton, D. L. (Ferranti Packard Ltd., Toronto). Dec 1972.

From 39th meeting of the AGARD propulsion and energetics panel; Colorado Springs, Colorado, USA (12 Jun 1972).

A large lightweight saddle-coil superconducting dipole magnet for airborne MHD generators is described. The magnet has a room temperature bore of 27.7 cm, a winding bore of 33 cm, a design field of 4.5 tesla, a magnetic length of 105 cm and a mass of 450 Kg. The dipole field is generated by pancake windings whose cross sectional outline approximates overlapping circles. Lightweight necessitates high current density, 2,100A in a 2 mm. square conductor containing 200 twisted Nb-Ti filaments in a copper matrix. The Lorenz repulsive force between opposite sides of the magnet is 3850 Kg/cm of coil length. There are also large compressive forces on the former and repulsive forces between the ends. The mechanical structure therefore uses a highly stressed lightweight structure of filament wound epoxy—a "E" glass composite. The dewar uses superinsulation and vapor cooled radiation shields. Vibration and shock analysis and pressure vessel design criteria determine the minimum mass dewar design. (auth)

20916 (AGARD-CP-104, pp 23.1-23.12) METHOD FOR PRELIMINARY ANALYSIS OF MHD GENERATOR PERFORMANCE. Casci, C.; Coghe, A.; Ghezzi, U. (Politecnico, Milan). Dec 1972.

From 39th meeting of the AGARD propulsion and energetics panel; Colorado Springs, Colorado, USA (12 Jun 1972).

Recent development in the realization of MHD generators gives the possibility to use them also in special power plants, e.g. in aeronautics or space applications. For these latter cases, the typical operation features will be quite different from those of ground power plants, thus needing the elaboration of simplified methods of analysis, from which preliminary information will be available. The present paper introduces and utilizes a method able whether to cover very wide variability fields of parameters of a MHD generator, or to give the main elements to evaluate the convenience of the different configurations. This is obtained basically by fixing the total enthalpic difference between the inlet and outlet sections of the duct and by examining later the various possibilities through which such a condition can be achieved. Thermodynamic and electromagnetic quantities are studied in relation to the velocity difference between the inlet and outlet sections of the duct and by some parameters, such as expansion ratio and form factor of the duct. Some results obtained by the present method are shown in detail and then discussed from a qualitative point of view. A case similar to current projects for ground power plants is analyzed following the same procedure, to verify in such a way the correctness of the method. (auth)

20917 (IESD-3112-1) ECONOMIC RADIOISOTOPE THERMOELECTRIC GENERATOR STUDY PROGRAM. Final Technical Report. (Teledyne Isotopes, Timonium, Md. (USA). Energy Systems Div.). Oct 1973. Contract SNSO-3. 216p. Dep. NTIS $14.00.

This study was initiated April 2, 1973 to evaluate various radioisotope thermoelectric generator concepts and select a reference design which would provide a safe, reliable, economic 400 W(e) power supply for use in future space communication satellites. Nine basic concepts and 18 additional trade-off configurations were evaluated during the study program. The reference design ERTG is a generator with 400 W(e) EOM(5.5y) output, 15 standard heat source blocks, an improved all-selenide thermopile, and two heat pipe augmented fins for waste heat rejection. The generator uses ^{244}Cm as fuel but will accept ^{238}Pu. (TFD)

20918 (IESD-3112-2) ECONOMIC RADIOISOTOPE THERMOELECTRIC GENERATOR STUDY PROGRAM. Appendices. Final Technical Report. (Teledyne Isotopes, Timonium, Md. (USA). Energy Systems Div.). Oct 1973. Contract SNSO-3. 350p. Dep. NTIS $20.50.

This report consists of 14 appendices to the economic radioisotope thermoelectric generator (ERTG) study program described in IESD-3112-1. The appendices are entitled: Concept Summary Sheets; Low Temperature Heat Pipe Technology; Selenide T/E Technology and Test Data; Improved TAGS/2N T/E Technology; Bimetallic Seal Technology; Cold End Hardware Technology; Thermal Insulation Technology; Thermal Control Technology; Nuclear Safety Criteria; Heat Source Selection and Compatibility; Heat Source Response Analysis; Search and Recovery; Shield Analysis—Methods and Models; and Heat Pipe Attachment Techniques. (TFD)

20919 (IESD-3112-3) ECONOMIC RADIOISOTOPE THERMOELECTRIC GENERATOR STUDY PROGRAM. Program Plan. (Teledyne Isotopes, Timonium, Md. (USA). Energy Systems Div.). Nov 1973. Contract SNSO-3. 149p. Dep. NTIS $10.50.

This program plan describes the effort required to develop, test, and manufacture the 400 W(e) economic radioisotope thermoelectric generator (ERTG) for space applications. The initial program is described in IESD-3112-1. (TFD)

20920 (IESD-3112-4) ECONOMIC RADIOISOTOPE THERMOELECTRIC GENERATOR STUDY PROGRAM. Cost Effectiveness Study. (Teledyne Isotopes, Timonium, Md. (USA). Energy Systems Div.). Nov 1973. Contract SNSO-3. 57p. Dep. NTIS $6.00.

The recently completed economic radioisotope thermoelectric generator (ERTG) study, (IESD-3112-1) and its resulting design definition were greatly dependent on a parallel cost effectiveness study and the results of numerous cost trade-offs. Both the total program activity and the ERTG design have been cost optimized. (TFD)

20921 EXPERIMENTAL AND THEORETICAL STUDY OF A LONGITUDINAL END EFFECT IN AN INDUCTION MHD-MACHINE. Vol'dek, A. I.; Kienko, A. I.; Manoilova, O. N.; Mikirtichev, A. A.; Soldatenkova, N. A.; Tolvinskaya, E. V. Magn. Gidrodin.; No. 1, 107-111(1974). (In Russian).

On the basis of one-dimensional theory and a replacement circuit for a linear induction MHD-machine, calculations were carried out on the distribution of induction along the length of the machine, and on its overall parameters. Experimental studies were carried out on an arc-stator machine in which the distribution of inductance was obtained by means of measuring coils, while the overall parameters $r = f(s)$ and $x = f(s)$ were obtained from the operating characteristics $P_1 = f(s)$ and $I_1 = f(s)$. Corrections are introduced into the calculation data that take into account the transverse edge effect and also "nondampening" of the field (in an arc-stator machine the field in the inactive edge zones dampens slowly and again enters the active zone). Good agreement was obtained between calculated and experimental data. Recommendations are given in the design of linear induction machines. (SJR)

20922 METHOD OF CALCULATING AN ELECTROMAGNETIC BOAT (CHANNEL WITH ONE SIDE OPEN). Krumin, Yu. K. Magn. Gidrodin.; No. 1, 117-121(1974). (In Russian).

A short description is given of previously known methods of calculating the working characteristics of electromagnetic boats, and the insufficiencies of these methods are pointed out. One of the main deficiencies can be considered the difficulties in determining the rate of movement of the liquid metal and its mass flow. In order to remove these difficulties, a proposal is advanced to consider an equation connecting the mass flow of a metal with forces of hydraulic resistance to which a metal is subject in a channel during movement. This equation along with equations describing electromagnetic processes comprise a unified system of three equations which allows three of the independent parameters characterizing the operation of the boat (for example, metal layer thickness, mass flow and productivity or channel width) to be considered as unknowns and to be determined as a function of the remaining parameters. It is pointed out that conditions at the inlet end of the boat have a very great effect on the mass flow. The study introduces the concept of a maximum operating mode of a boat which is accomplished only in the case when metal in sufficient quantity enters the boat. The set of equations is considered both for the maximum operating mode of the boat and for an operating mode with less than a full charge. (SJR)

20923 STUDY OF THE MOVEMENT OF A LIQUID METAL TONGUE AT ZERO-THROUGHPUT ALONG AN ELECTROMAGNETIC BOAT (CHANNEL WITH ONE SIDE OPEN). Krumin, Yu. K. Magn. Gidrodin.; No. 1, 122-126(1974). (In Russian).

With the use of concepts of translational motion dynamics and on taking into account electrodynamic and gravitational forces, a description is given for the forward motion of a liquid metal tongue along an electromagnetic boat at a current in the inductor

which is not sufficient that the metal reach the exit end of the boat. Comparison with experimental data indicates that this concept may be taken as a base for further development of the theory of movement of a metal in the channel of an electromagnetic boat. (SJR)

20924 STUDY OF EDDY FORCES IN A LIQUID METAL IN THE FIELD OF A SINGLE-PHASE INDUCTOR. Tir, L. L. Magn. Gidrodin.; No. 1, 127-135(1974). (In Russian).

Consideration is given to eddy forces in a single-phase, axially-symmetric, electromagnetic system containing molten metal. Expressions are presented for the rotor of the forces in the general case of an axially-symmetric system and in the partial cases of azimuthal orientation of the current density or magnetic induction. An analysis is made of the role of frequency and limiting conditions to eddying of the forces. Formulas and numerical data are presented on the force fields in a system with azimuthal currents at various kinds of distribution of induction at the boundary of the liquid metal. It is shown that the inhomogeneity of the boundary conditions decreases the effective depth of field penetration and the maximum values of the forces in the metal. The effect of the ratio of the thickness of the skin layer and of the characteristic size of the inductor on the value of the force rotor and integral characteristics of the eddy zone are illustrated by curves. It is shown that at a metal height exceeding the inductor length the integral effect of eddy, electromagnetic forces in the melt is approximately characterized by a maximum value of the pressure of these forces in the surface metal layer. (SJR)

20925 MODELING THE HYDRODYNAMICS OF AN ELECTROMAGNETIC TREATMENT OF A FLOWING LIQUID METAL BY SOLID REAGENTS. Chekin, B. V.; Doronin, V. I.; Boyarenko, V. V.; Lesovoi, V. V. Magn. Gidrodin.; No. 1, 143-146(1974). (In Russian).

By means of modeling, the conditions were found at which an equilibrium distribution of reagent particles 2 to 10 mm in diameter is attained in a flow of liquid iron when the ratio of iron density to reagent density is 1.3. The liquid model was a 25% aqueous salt solution, while the reagent model consisted of polystyrol particles 0.75 to 4 mm in diameter. A study was carried out on the effect of electromagnetic forces, oriented opposite to the force of gravity, on the profile of averaged, longitudinal velocities and the distribution of particles along the height of the flow current both in the working zone of the channel and beyond its limits. (SJR)

20926 EFFECT OF THE ELECTRICAL CONDUCTIVITY OF A SUPPLEMENTARY MAGNETIC CONDUCTOR ON THE CHARACTERISTICS OF INDUCTION MHD-DEVICES. Veselov, I. V.; Krumin, Yu. K.; Shkol'nikov, A. F. Magn. Gidrodin.; No. 1, 112-116(1974). (In Russian).

A study was made on the degree of worsening of the parameters of MHD-machines caused by making the supplementary magnetic conductor not blended but in the form of a continuous ferromagnetic body having a finite electrical conductivity. In this case two problems were solved in which the electromagnetic processes in the conducting bodies (pole and field cylinder) were determined. In both cases expressions were obtained for the longitudinal component of the electrodynamic force averaged with respect to time and cross-section. Results are presented on measurements of the force acting on a hollow aluminum cylinder placed in a cylindrical, traveling-field inductor. Calculated values of the force agree well with experimental data. (SJR)

Facilities and Equipment

Refer also to abstracts 21306, 21686, 21816, and 21832.

20927 (COO-2007-47) ADVANCED COUPLING OF NUCLEAR REACTOR-GAS LASER SYSTEMS. Technical Progress Report, August 31, 1973-August 31, 1974. Verdeyen, J. T.; Miley, G. H.; Wells, W. E. (Illinois Univ., Urbana (USA)). 1974. Contract AT(11-1)-2007. 42p. Dep. NTIS $5.25.

The present research is concerned with the use of nuclear radiation for either direct pumping and/or enhancement of the operation of gas lasers. The achievement of either or both objectives would potentially provide an importance advancement in laser technology. First, these techniques should have ultimate application in high pressure, hence high power lasers. Second, it is conceivable, and has in fact been shown during the present work, that lasers with new lines and characteristics may result from nuclear irradiation. Finally, if, as is envisioned for many high power lasers, a nuclear power source (fission reactor, radioisotope, or fusion reactor) is to be used, this offers the most efficient ways to couple the source and laser. Progress during the current contract period is reported for specific studies under the following section headings: (1) pumping and enhancement of chemical lasers, (2) studies of electron distributions, (3) pumping and enhancement of noble gas lasers, and (4) spectroscopic studies of irradiated gases. (auth)

20928 (HEDL-TME-74-24) PROTOTYPE APPLICATIONS LOOP TWO YEARS OF OPERATION. McCown, J. J. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Mar 1974. Contract AT(45-1)-2170. 28p. AT.

The Prototype Applications Loop (PAL) has been operated continuously for two years. Prototype characterization hardware prooftesting has been completed. A new side loop has been added for valve leakage testing and a second will be added early in FY-1975 for Flow Impedance Studies. The PAL Sodium Characterization System is presently in use for field testing sodium analysis methods, for evaluating commercial hydrogen meters and for testing new on-line monitor concepts. Details of the second year of test work are described. (auth)

20929 (LA-5608-MS) NUMERICAL SOLUTION OF MELT FLOW AND THERMAL ENERGY TRANSFER FOR THE LITHO-THERMODYNAMICS OF A ROCK-MELTING PENETRATOR. McFarland, R. D. (Los Alamos Scientific Lab., N. Mex. (USA)). May 1974. Contract W-7405-eng-36. 20p. Dep. NTIS $4.00.

A finite-difference numerical method is described for computing the steady-state thermal and hydrodynamic characteristics of the melt flow around a heated rock-melting penetrator of arbitrary axisymmetric geometry. The major operating and performance results obtained from these calculations are heated-surface power, required thrust load, and the thickness profile of the melt layer. The method described has been incorporated in a computer program, and some typical results are presented. (auth)

20930 (ORNL-4925) FOURTH ANNUAL PROGRESS REPORT ON STUDIES IN APPLIED SOLID MECHANICS (PRESSURE VESSELS AND PIPING SYSTEM COMPONENTS). (Oak Ridge National Lab., Tenn. (USA)). Jul 1974. Contract W-7405-eng-26. 151p. AT.

Accomplishments during calendar year 1972 under two AEC-sponsored solid mechanics programs, one on piping system components and the other on pressure vessels, are summarized. The two programs are titled "Design Criteria for Piping, Pumps, and Valves" and "Nozzles Analysis", respectively. Under these programs, certified methods for design analyses are being established through carefully coordinated experimental and analytical studies, analytical parametric studies are being conducted, and empirical data correlations are being made. From the results obtained, design rules and analytical procedures are then developed for incorporation into current industry-developed codes and standards and/or into the USAEC RDT standards. Thus, end products of the two programs are information and guidance for assuring structural integrities of nuclear reactor pressure vessels and piping systems. The technology, however, is not limited to nuclear systems but may be applied to nonnuclear systems as well. The ORNL Piping Program (Design Criteria for Piping, Pumps, and Valves) and the ORNL Nozzles Analysis Program are discussed in Parts I and II respectively. (auth)

20931 (TRG-REPORT-2504(R)) SIMPLE TRIANGULAR MEMBRANE FINITE ELEMENT. Ellington, J. P. (UKAEA Reactor Group, Risley). Apr 1974. 11p. Dep. NTIS (US Sales Only) $4.00.

The transformation matrix connecting local axes lying in the plane of an arbitrarily oriented simple triangular membrane finite element, and the overall, or global, axes, is established and used to transform the local stiffness matrix and nodal loads of a triangular constant-strain element to give global representation. (auth)

20932 (UCRL-51613) STUDIES OF LASER CALORIMETERS USING GLASS ABSORBERS AND BLACK-PAINTED ABSORBERS FROM 0.46 TO 1.06 μm. Gunn, S. R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 10 Jul 1974. Contract W-7405-Eng-48. 9p. Dep. NTIS $4.00.

Studies of calorimeters with black-painted absorbers and various glass absorbers at several laser frequencies from 457.9 to 1064 nm, CW, and at 694 nm, pulsed, are described. Reflectances of the absorbers were studied using a previously described reflectance calorimeter, and some transmittances of the glasses were measured. One of the calorimeters was compared with a previously described tubular calorimeter, and another with a reference calorimeter at the National Bureau of Standards. (auth)

20933 (UCRL-74959) X-RAY LASERS: NECESSARY CONDITIONS. Slutz, S.; Zimmerman, G.; Lokke, W. (California Univ.,

Livermore (USA). Lawrence Livermore Lab.). 26 Oct 1973. 14p. (CONF-731009-12). Dep. NTIS $4.00.

From annual plasma physics meeting of the American Physical Society; Philadelphia, Pennsylvania, USA (31 Oct 1973).

Necessary conditions for the attainment of x-ray laser action are discussed. These conditions are believed to be an essentially self evident necessity for the restricted set of circumstances treated, i.e., cylinders of potentially x-ray lasing media of large aspect ratio without an external optical cavity. Only lasers operating on bound-bound transitions, whose practical feasibility are great relative to those coupling free-free or free-bound transitions, whose gain widths are effectively very broad and whose peak gains are relatively very small are treated. (MOW)

20934 (UCRL-75752) NONLINEAR PROPAGATION STUDIES. Bliss, E. S. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 3 Jun 1974. 19p. (CONF-740524-4). Dep. NTIS $4.00.

From ASTM Workshop; Boulder, Colorado, USA (22 May 1974).

The desire to avoid damaging the components of high-power solid-state laser-systems being built for laser fusion experiments has led to increased interest in all aspects of intense pulse propagation. A variety of observations of nonlinear propagation phenomena is described and the instrumentation used for measuring them. Comparisons with theoretical predictions are presented, and some approaches to minimization of the resulting problems in large systems are outlined. The intent is to present an up-to-date summary of the progress being made in characterizing and controlling nonlinear propagation effects. (auth)

20935 LASER DEVICES AND APPLICATIONS. Kaminow, I. P.; Siegman, A. E. (eds). New York; John Wiley and Sons, Inc. (1973). 500p. $14.95.

A separate abstract was prepared for each of eight papers dealing with laser research. (MOW)

For abstracts of individual papers see: 20936–20943.

20936 CRYSTALLINE SOLID LASERS. Kliss, Z. J.; Pressley, R. J. (RCA Labs., Princeton, NJ). pp 24-36 of Laser Devices and Applications. Kaminow, I. P. (ed.). New York; John Wiley and Sons, Inc. (1973).

A survey of crystalline solid lasers is presented. Crystalline host materials are described, pointing out their characteristics pertinent for laser systems. Rare earth and transition metal impurities operated as lasers are tabulated and the role of sensitization in increasing the overall efficiency of laser systems is described. Characteristics of operating CW lasers are given, and some applications and research directions are suggested. (auth)

20937 GLASS LASERS. Young, C. G. (American Optical Central Research Lab., Southbridge, MA). pp 37-59 of Laser Devices and Applications. Kaminow, I. P. (ed.). New York; John Wiley and Sons, Inc. (1973).

In the eight years since the first publication of glass laser operation, considerable progress has been made in this technology with 5 active laser ions operating at 7 emission wavelengths having been confirmed so far. Laser action has been obtained in time regimes from continuous wave to pulsed operation with pulse widths down to 2.5×10^{-13} second. In addition, glass lasers currently provide the highest energy, the highest peak power, and the highest radiance laser sources. An efficiency of energy conversion to the optical second harmonic at 530 nm exceeding 50% has been obtained. Recent developments show promise of equaling gas laser performance in coherence length and average power. Present energy conversion efficiencies of over 8% and the development of a fiber laser receiver preamplifier are making glass laser systems applications increasingly attractive. This paper reviews the evolution of glass lasers, describes some recent developments, and discusses a number of applications in this fast-growing field. (auth)

20938 SEMICONDUCTOR LASERS. Nathan, M. L. (IBM Thomas J. Watson Research Center, Yorktown Heights, NY). pp 60-74 of Laser Devices and Applications. Kaminow, I. P. (ed.). New York; John Wiley and Sons, Inc. (1973).

A review is presented of semiconductor laser work. The principles of operation are discussed. The stress is on work since early 1964. The present state-of-the-art in GaAs junction lasers is described. (auth)

20939 FLASHLAMP-EXCITED ORGANIC DYE LASERS. Snavely, B. B. (Eastman Kodak Research Labs., Rochester, NY). pp 75-91 of Laser Devices and Applications. Kaminow, I. P. (ed.). New York; John Wiley and Sons, Inc. (1973).

The flashlamp-excited dye laser is presently the only type of laser capable of tunable emission throughout most of the visible spectrum. Gain and power output of the device are comparable to solid-state systems although the laser performance is hindered by thermal effects, produced by spatially nonuniform excitation of the dye, and optical losses associated with the molecular triplet state. In most of the known laser dyes, steady-state lasing is prevented by triplet state effects. The analysis of the gain of the dye laser is discussed in terms of the singlet-state absorption and fluorescence and triplet-state absorption spectra. The gain analysis is used to study the influence of the triplet state upon the critical inversion, and application of the analysis to a specific system is illustrated by the detailed discussion of the rhodamine 6G laser. A criterion for the maximum permissible triplet-state lifetime consistent with CW operation is given. The quenching of the triplet state of rhodamine 6G is shown to be rapid enough to allow CW operation, although thermal effects seem to be serious. The investigation of thermal effects is reviewed and the advantages of uniform excitation of the dye are pointed out. The minimum optical excitation power required for CW operation of a 7-cm-long rhodamine 6G laser of 2 mm diameter is estimated to be 850 watts neglecting thermal effects. A catalog of dyes, with their structures, that have been used in flashlamp-excited dye lasers is given. Various methods of tuning and mode locking the dye laser are reviewed. With a single dye a tuning range of 40 nm may be obtained by substituting a diffraction grating for one of the laser mirrors. Mode locking can be produced by placing a saturable dye absorber in the cavity. (auth)

20940 ION LASER PLASMAS. Bridges, W. B. (Hughes Research Labs., Malibu, CA); Chester, A. N.; Halsted, A. S.; Parker, J. V. pp 94-107 of Laser Devices and Applications. Kaminow, I. P. (ed.). New York; John Wiley and Sons, Inc. (1973).

The typical noble gas ion laser plasma consists of a high-current-density glow discharge in a noble gas, in the presence of a magnetic field. Typical CW plasma conditions are current densities of 100 to 2000 A/cm^2, tube diameters of 1 to 10 mm, filling pressures of 0.1 to 1.0 torr, and an axial magnetic field of the order of 1000 G. Under these conditions the typical fractional ionization is about 2% and the electron temperature between 2 and 4 eV. Pulsed ion lasers typically use higher current densities and lower operating pressures. This paper discusses the properties of ion laser plasmas, in terms of both their external discharge parameters and their internal ion and excited state densities. The effect these properties have on laser operation is explained. Many interesting plasma effects, which are important in ion lasers, are given attention. Among these are discharge nonuniformity near tube constrictions, extremely high ion radial drift velocities, wall losses intermediate between ambipolar diffusion and free fall, gas pumping effects, and radiation trapping. The current status of ion laser technology is briefly reviewed. (auth)

20941 HIGH PEAK POWER GAS LASERS. Beaulieu, J. A. (Defense Research Establishment Valcartier, Quebec). pp 108-115 of Laser Devices and Applications. Kaminow, I. P. (ed.). New York; John Wiley and Sons, Inc. (1973).

The development of transversely excited atmospheric pressure (TEA) CO_2 lasers has led to the generation of multimegawatt laser pulses at 10.6 μm in simple laboratory prototypes. A discussion of the basic properties of these lasers is followed by the description of a number of different techniques that have been used to provide effective transverse excitation of lasers at low repetition rates. The basic technique used to increase the repetition rates to 1000 pulses per second (PPS) is described. Considering the simplicity of the technique and its low cost, it appears that in the not too distant future, pulse energies in the kilojoule region and pulse lengths of the order of one nanosecond will be practical. (auth)

20942 GASDYNAMIC LASERS. Gerry, E. T. (Avco Everett Research Lab., Washington, DC). pp 116-123 of Laser Devices and Applications. Kaminow, I. P. (ed.). New York; John Wiley and Sons, Inc. (1973).

It is not enough to depend upon diffusivity to dissipate the heat from a gas laser. Under the circumstances, average power outputs are too limited. By generating flow within the gas and deriving the benefits of forced convection, performance is improved. But if flow can be used to improve power outputs, it also can be used to advance a step further and generate the conditions that are necessary for lasing action—thereby creating a gasdynamic laser. This article covers the theory behind such a device and describes an experimental unit that has proved the merit of the concept. (auth)

20943 CHEMICAL LASERS: A SURVEY OF CURRENT RESEARCH. Chester, A. N. (Hughes Research Labs., Malibu, CA). pp 124-132 of Laser Devices and Applications. Kaminow, I. P. (ed.). New York; John Wiley and Sons, Inc. (1973).

A brief summary is presented of recent chemical laser research. The principal emphasis is on current device performance, particularly those areas where promising new work is being done. Chemical kinetics and theoretical modeling are not discussed in detail, but extensive references are provided for the reader who wishes to pursue these subjects in greater depth. (auth)

20944 BEAM CHARACTERISTICS OF A LIDAR SYSTEM. Landry, M. J. (Sandia Labs., Albuquerque, NM). Appl. Opt.; 13: No. 1, 63-73(Jan 1974).

The variations in four-beam characteristics of a high repetition rate, giant pulse, ruby laser Lidar system were investigated as functions of five controllable laser parameters. The beam characteristics investigated were divergence, intensity distribution, directivity, and consistency of output energy. The variations in the laser beam characteristics were monitored as functions of ruby rod temperature, ruby rod quality, pumping repetition rate, cavity loss, and pumping energy. The resulting requirements on the pumping repetition rate in order to obtain minimums in laser beam divergence and deviation in the laser output energy were mutually exclusive. The results indicate that a laser oscillator-amplifier system with automatically controllable cavity mirrors would give more consistency in output energy and intensity distribution than lasers presently used in Lidar systems. (auth)

20945 VORTEX STABILIZED FLASHLAMPS FOR DYE LASER PUMPING. Mack, M. E. (United Aircraft Research Labs., East Hartford, CT). Appl. Opt.; 13: No. 1, 46-55(Jan 1974).

A unique vortex gas flow stabilized flashlamp was developed for dye laser pumping. With a 2-μsec current pulse the flashlamp can be operated at up to 250 J/pulse and can be run at a pulse repetition rate of up to 20 pulses/sec. At 200 J/pulse the useful lamp lifetime is several hundred thousand shots. Used for pumping the rhodamine 6G dye laser, the lamp has produced a 10-W average dye laser output. (auth)

20946 DYE LASERS: A CLASSIFIED BIBLIOGRAPHY 1966-1972. Magyar, G. (European Space Research Inst., Frascati, Italy). Appl. Opt.; 13: No. 1, 25-45(Jan 1974).

A bibliography of dye lasers has been compiled starting with the year 1966, when the first definitive report of a dye laser was published by Sorokin et al., and continuing through 1972. (auth)

20947 SPIN-FLIP RAMAN LASERS. Patel, C. K. N. (Bell Telephone Labs., Inc., Hoimdel, NJ). pp 689-721 of Fundamental and Applied Laser Physics. Feld, M. S. (ed.). New York; John Wiley and Sons, Inc. (1973).

Recent work in the field of Raman lasers is reviewed. Very recent developments in the field which has led to the operation of the spin-flip Raman laser at magnetic fields as low as 400 G are discussed. This development allows one to obtain tunable spin-flip Raman laser radiation without having to resort to a superconducting magnet for the magnetic field. Some of the applications of the spin-flip Raman laser are summarized in areas such as high-resolution spectroscopy, transient infrared spectroscopy, pollution detection using the spin-flip Raman laser, and further nonlinear optics using the spin-flip Raman laser. (auth)

20948 PHOTON MACHINES. Hertzberg, A.; Christiansen, W. H.; Johnston, E. W. (Univ. of Washington, Seattle). pp 141-164 of Fundamental and Applied Laser Physics. Feld, M. S. (ed.). New York; John Wiley and Sons, Inc. (1973).

The basic thermodynamics of thermal lasers of the gas-dynamic type are reviewed, and it is shown that an efficient coherent photon generator can be developed on a closed-cycle principle. The efficiency limits of such a device are explored, and the results of the analysis indicate that the production efficiency of coherent radiation from heat can, in the limit of high component efficiency, be equal to that of the production of work. An indispensable element of any power transmission system also involves an engine capable of transforming the transmitted energy into useful shaft power. It is shown that a closed-cycle system may also be developed in principle which can transform the transmitted laser radiation into shaft power with an efficiency approaching one. (auth)

20949 RECENT RESULTS ON SELF-FOCUSING AND TRAPPING. Shimizu, F.; Courtens, E. (IBM Forschungslaboratorium, Rueschlikon, Switzerland). pp 67-79 of Fundamental and Applied Laser Physics. Feld, M. S. (ed.). New York; John Wiley and Sons, Inc. (1973).

Both theoretical and experimental results on the self-focusing and trapping of optical beams in nonlinear media are presented. For relatively long single-mode pulses, the steady-state theory describes well the experimental results. For short pulse excitation, it is necessary to account for the relaxation time of the medium. The theory then seems adequate for the description of observed filaments without having to resort to saturation of the nonlinearity. (auth)

20950 LASER BEAM SELF-FOCUSING. Prokhorov, A. M. (Inst. of Physics, Moscow). pp 51-65 of Fundamental and Applied Laser Physics. Feld, M. S. (ed.). New York; John Wiley and Sons, Inc. (1973).

A review and analysis are given of recent theoretical and experimental investigations of the self-focusing of a laser beam in a nonlinear medium. The multifoci structure of self-focusing is mathematically elaborated. The role of multiphoton absorption in focusing processes is emphasized. Observations of self-focusing in liquids and glasses using single-mode lasers are analyzed, showing good agreement between the experimental data and the theoretical curve for the foci position vs field strength. (IAA)

20951 STUDIES ON THE PEAK STRESS INDEX OF PIPING ELEMENTS. Test and Studies on Structural Design Standards for Nuclear Power Piping. I. Tokyo; Japan Welding Engineering Society (1973). 165p. (In Japanese).

In the ASME Boiler and Pressure Vessel Code Sec. III "Nuclear Power Components", stress indices and deflection factor are introduced to simplify strength calculation, and their values for piping elements are given, but there are many points to be restudied. The SIP subcommittee began research for re-evaluating them theoretically and experimentally. Branched pipes and bent pipes were selected as the piping elements to be examined, and low-cycle fatigue tests were carried out. The research was started in June 1971 and finished in July 1972. The fatigue strength of the piping elements was lower than that of small test pieces in most cases. Accordingly, fatigue strength reduction factors must be taken into account in the fatigue design of piping elements. Virtual elastic analysis can be applied to the structural analysis of piping elements, but in this case, the deflection factor after plastic deformation must be known beforehand. The peak stress indices K1 and K2 for branched pipes and bent pipes given in the US codes are slightly too small. Therefore, they should be multiplied by the fatigue strength reduction factor. At the same time, statically indeterminate structural analysis must be adopted for the strength design method in the low-cycle fatigue design of piping. By this method, the safety and reasonability of structural strength design for reactor piping can be guaranteed. (JA)

20952 STUDIES ON THE EFFECT OF DEFECTS OF A PIPE JOINT ON THE FATIGUE STRESS INDEX. Test and Studies on Structural Design Standards for Nuclear Power Piping. II. Tokyo; Japan Welding Engineering Society (1972). 237p. (In Japanese).

In the USA, structural design standards for pressure vessels and reactor piping were instituted, but the data used for their basis are unsatisfactory in view of advanced techniques at present. The present research was carried out for the purpose of elucidating the effect of welding defects upon the fatigue stress indices in the US standards. Research work on the internal pressure fatigue of seam-welded cylinders involving internal defects such as blowholes, slag inclusions, undercuts, incomplete penetration, and the bending fatigue of butt welded cylinders with external welding defects such as joint misalignment, weld reinforcement and its shape is described. This research began in June 1970, and was finished in June 1971. The effect of welding defects on low-cycle fatigue strength was most intensive in the case of incomplete penetration, and was relaxed in the following order, undercuts, slag inclusions, local distribution of blowholes, and uniform distribution of blowholes. In the bending fatigue test, the shape of internal surface corner and surface roughness were more effective as notches than misalignment and weld reinforcement themselves. The research by fractography was carried out on the fractured surfaces in both tests. Considerable striation was observed on the fractured surfaces, which is evidence of fatigue fracture. (JA)

20953 FUNDAMENTAL AND APPLIED LASER PHYSICS. Feld, M. S.; Javan, A.; Kurnit, N. A. (eds.). New York; John Wiley and Sons, Inc. (1973). 933p. $27.50.

Aspects of nonlinear optics are discussed, giving attention to picosecond optics, laser beam self-focusing, short pulse nonlinearities, and ultrashort laser pulses and applications. Plasma heating and controlled fusion are considered together with lasers in chemistry, emission processes and optical pumping, and the future course of quantum electronics. Subjects in the field of spectroscopy are also explored, taking into account narrow resonances and precision applications, the spectroscopy of gases, the spectroscopy of condensed matter, and tunable sources and their applications. (IAA)

20954 BEAM DIAGNOSTICS FOR HIGH ENERGY PULSED CO_2 LASERS. O'Neil, R. W. (Massachusetts Inst. of Tech., Lexington); Kleiman, H.; Marquet, L. C.; Kilcline, C. W.; Northam, D. Appl. Opt.; 13: No. 2, 314-321(Feb 1974).

To examine high energy CO_2 pulsed laser beams, reliable sampling and attenuation procedures were devised using the properties of coarse transmission gratings and diffuse scatter from specular metal mirrors. Details of measurements and alignment procedures are described including a single shot, nondisruptive method for effectively scanning the time integrated focal distribution of a high energy pulsed laser. In addition, it is shown that a simple multiple burn pattern technique can be used for the quantitative measurement of the integrated distribution. The data obtained demonstrate near diffraction-limited capability for large e-beam lasers with unstable resonators. (auth)

20955 EARLY TERMINATION OF FLASHLAMP PUMPED DYE LASER PULSES BY SHOCK WAVE FORMATION. Bilt, S.; Fisher, A.; Ganiel, U. (Weizmann Inst. of Science, Rehovot, Israel). Appl. Opt.; 13: No. 2, 335-340(Feb 1974).

The problem of early termination of laser action in flashlamp pumped dye lasers is investigated. It is found that in high power, short pulse duration systems shock waves are created in the dye solution. Index inhomogeneities in the laser medium are created, and these lead to the termination of laser action. The velocity of propagation of the disturbance is measured. Some possibilities concerning the origin of these shock waves are examined. A design scheme that overcomes the effect of the disturbance in short pulse (≤ 5 μsec) systems is described. (auth)

20956 RATE EQUATIONS OF HIGH GAIN LASERS AND DETERMINATION OF LASER PARAMETERS. Kaufman, Y. J.; Oppenheim, U. P. (Technion-Israel Inst. of Tech., Haifa, Israel). Appl. Opt.; 13: No. 2, 374-378(Feb 1974).

Rate equations are developed to describe the behavior of high gain lasers. The solution of these equations for cw operation of such lasers is the same as that obtained by Rigrod. An experimental method is described to find the gain, saturation irradiance, and losses of a given laser. This method is illustrated for a CO_2 laser. The pumping rate and lifetime of the upper laser level of this laser are established. The optimum transmittance of the coupling mirror is also calculated, using the data obtained for the actual gain, saturation, and losses in the laser. Good agreement with experiment is found. (auth)

20957 VERY LONG LASERS. Linford, G. J.; Peressini, E. R.; Sooy, W. R.; Spaeth, M. L. (Hughes Aircraft Co., Culver City, CA). Appl. Opt.; 13: No. 2, 379-390(Feb 1974).

The properties and oscillation characteristics of very long cw xenon lasers are discussed and pertinent long laser experiments described. High-gain 3.508-μm xenon laser amplifiers were used in these experiments. Laser cavity lengths of up to 30 km were studied. Spectrum analyses revealed complex oscillation spectra exhibiting the characteristics of both homogeneous and inhomogeneous laser mode structures. Long laser Doppler experiments, Q-switching studies, and modulation experiments were performed. Applications to atmospheric pollution detection are discussed. (auth)

20958 STABLE CW HCN LASER. Yoshihiro, K.; Yamanouchi, C. (Electrotechnical Lab., Tanashi, Japan). Rev. Sci. Instrum.; 45: No. 6, 767-768(Jun 1974).

Techniques are described which have been found adequate for operating a HCN laser with stable cw action at wavelengths of 337 and 311 μ; the fluctuation of output power is about ±2% without intentional stabilization by retuning for over 10 h. The main features of the design are: (1) a mixture of CH_4, N_2, and He gases is used as the flowing gas with a mixing ratio of 1:1:2 by volume; total pressure of 1.6 torr and gas flowrate of 6 ~ 8 liter torr/min; (2) the fluctuation of gas pressure is kept within 0.01 torr; and (3) the cathode is not grounded but negatively charged about 10% of the dc source voltage. Some of these techniques are applicable to other HCN lasers. (auth)

20959 MULTILINE MODE-LOCKED UV-PREIONIZED CO_2 LASER. Richardson, M. C. (National Research Council of Canada, Ottawa). Appl. Phys. Lett.; 25: No. 1, 31-33(1 Jul 1974).

A uv-photopreionized TEA CO_2-N_2 discharge is incorporated in an actively mode-locked CO_2 laser system capable of producing individual pulses of peak power of >200 MW with durations ~1 nsec. Spectral examination of the laser output indicates that oscillation occurs simultaneously on several rotational lines of the 10.4-μ band. (auth)

20960 FORMATIVE TIME LAGS IN CO_2 LASER DISCHARGES. Crawford, E. A. (Univ. of Colorado, Boulder); Phelps, A. V. Appl. Phys. Lett.; 25: No. 1, 59-61(1 Jul 1974).

Time lags for the growth of power input, i.e., formative time lags, were measured in typical CO_2 laser gas mixtures at pressures from 200 to 760 torr using parallel plane electrodes with the 1- and 2-cm gaps illuminated by a trigger discharge. The measured time lags are about twice the values predicted using a single avalanche growth model and theoretical ionization and attachment coefficients. (auth)

20961 FREQUENCY OFFSET OF A STABILIZED LASER DUE TO MODULATION DISTORTION. Blair, D. P. (Univ. of New England, Armidale, Australia). Appl. Phys. Lett.; 25: No. 1, 71-73(1 Jul 1974).

The response of a phase-sensitive detector is examined when its input signal is derived by modulation of a laser-saturated absorption line shape. Neglecting the laser background power curve, it is shown that second-harmonic distortion in the modulation gives rise to the largest laser frequency offset, 0.2% of such distortion yielding approximately 4.5 kHz frequency offset. The distortion effects are also examined when the background power curve is included. (auth)

20962 LASER EMISSION AT 3577 AND 3805 A IN ELECTRON-BEAM-PUMPED Ar–N_2 MIXTURES. Searles, S. K.; Hart, G. A. (Naval Research Lab., Washington, DC). Appl. Phys. Lett.; 25: No. 1, 79-82(1 Jul 1974).

Experiments were performed with electron-beam-pumped Ar–N_2 mixtures. Laser emission on the second positive band transitions 3577 Å (0 to 1) and 3805 Å (0 to 2) was observed in an optical cavity fitted with Brewster angle windows. Some exciting preliminary experiments in which the laser windows were mounted at normal incidence were performed. These results indicated superfluorescent emission with an efficiency of 0.4%. The energy pathways in the irradiated mixtures were modeled and compared to the experimental results. (auth)

20963 EFFICIENT HIGH-ENERGY-DENSITY MOLECULAR XENON LASER. Hughes, W. M. (Los Alamos Scientific Lab., NM); Shannon, J.; Hunter, R. Appl. Phys. Lett.; 25: No. 1, 85-87(1 Jul 1974).

Electron beam excitation of pure Xe and Xe–Ar and Xe–Ne gas mixtures was studied. Significant differences in the temporal character of ultraviolet output were observed. Under the best conditions laser output of 75-MW peak power and 0.76-J output energy were achieved. The molecular xenon laser is established as having the highest power in the wavelength region short of red. (auth)

20964 INTENSE TUNABLE PICOSECOND PULSES IN THE INFRARED. Laubereau, A.; Greiter, L.; Kaiser, W. (Technische Univ., Munich). Appl. Phys. Lett.; 25: No. 1, 87-89 (1 Jul 1974).

Single picosecond pulses of a Nd:glass laser are used in a single-pass generator to produce intense ultrashort infrared pulses. Starting from quantum noise, stimulated three-photon parametric amplification over ~12 orders of magnitude is achieved in a $LiNbO_3$ crystal at a pump intensity of 10^{10} W/cm^2. Angular tuning provides a frequency range of 2500-7000 cm^{-1}. High conversion efficiencies exceeding 1% are measured without crystal damage. (auth)

20965 COMPARISON OF H_2 AND HBr AS CAVITY FUELS IN A cw HF LASER. Cummings, J. C.; Dube, C. M.; Witte, A. B. (TRW Systems, Redondo Beach, CA). Appl. Phys. Lett.; 25: No. 1, 89-92(1 Jul 1974).

H_2 and HBr are compared as cavity fuels in a 1-kW arc-driven cw HF chemical laser. Closed-cavity power is presented as a function of fuel flowrate and lasing-axis position. Peak power observed was ~350 W with HBr, ~600 W with HBr and He, and ~1100 W with H_2. Spectral content of the laser beam indicated dominant 1-0 and 2-1 vibrational transitions with H_2, and 2-1 and 3-2 transitions with HBr. (auth)

20966 INSTRUMENTS AND METHODS FOR STUDYING RADIOACTIVE AEROSOLS. Review. Zaraev, O. M. At. Tekh. Rubezhom; No. 8, 34-40(1973). (In Russian).

Methods and the centrifugal equipment used for studying the dispersion of radioactive particles according to aerodynamic diameters, for studying the dependence of the specific activity of particles on their dimensions, and for measuring the density and coefficient of particle shape are described. A widely used method of studying the chemical properties of radioactive aerosols is measurement of their solubility in actual or model physiological liquids in non-equilibrium states. (INIS)

20967 STABILIZATION OF A ^{3}He-^{22}Ne LASER BY SATURATED ABSORPTION IN $^{129}J_2$-WAVE LENGTH DETERMINATION. Helmcke, J.; Bayer-Helms, F. (Physikalisch-Technische Bundesanstalt, Braunschweig (F. R. Germany)). Metrologia; 10: No. 2, 69-71(Apr 1974). (In German).

4 figs.; 14 refs.

Mechanical design and electronic circuit are described. Locking to one of the absorption lines of $^{129}J_2$ has been achieved with the third harmonic of the modulation frequency in the power output. The wavelength of the laser stabilized to the component $^{129}J_2$, B was measured in comparison to the ^{86}Kr-primary standard to be $\lambda_{vac} = 632990,076,\times 10^{-12}$m with a relative standard deviation of the mean value of about 2×10^{-9} (not including the uncertainty in the realization of the metre definition). (GE)

20968 SOLID STATE DEVICES. Proceedings of the 5th International Conference, Tokyo, Japan, August 29–31, 1973. J. Jap. Soc. Appl. Phys., Suppl.; 43: 1-517(1974). (CONF-730861–).

Separate abstracts were prepared for seven of the included papers. (MOW)

For abstracts of individual papers see: 20969–20974 and 22539.

20969 SPECTRAL AND SPATIAL BEHAVIOR OF LUMINESCENCE FROM THE ACTIVE LAYER OF GaAs–$Ga_{1-x}Al_xAs$ DOUBLE HETEROSTRUCUTRE LASER DIODES. Nakada, O.; Ito, R.; Nakashima, H.; Chinone, N. (Central Research Lab., Hitachi Ltd., Tokyo). J. Jap. Soc. Appl. Phys., Suppl.; 43: 43-48 (1974).

From 5th international conference on solid state devices; Tokyo, Japan (29 Aug 1973). See CONF-730861–.

Interconnections between luminescence properties and lasing characteristics of GaAs–$Ga_{1-x}Al_xAs$ double heterostructure (DH) laser diodes with a relatively pure active layer (the carrier density $\sim 10^{16}$) are studied. Nondestructive observation techniques for spectral and spatial behavior of luminescence from the active layer in DH laser diodes are specially developed for this purpose. Experimental results on diodes with a relatively pure active layer revealed the recombination mechanisms involved in lasing, together with several distinguished lasing characteristics, such as low thresholds, a steep rise of the gain with current and simultaneous lasing at low temperatures in two different recombination bands. Various kinds of grown inhomogeneities in the active layer are discriminated, and deteriorated performances of lasing are attributed to them. Further, the degradation of diodes in operation is found to be accompanied by generation and development of inhomogeneous and/or homogeneous darkening of luminescence in several modes. Effects of stress on luminescence homogeneity and degradation are also discussed. (auth)

20970 VISIBLE LIGHT-EMITTING SEMICONDUCTOR LASERS OF DOUBLE HETEROSTRUCUTRE. Itoh, K. (Matsuhita Electronics Corp., Osaka, Japan). J. Jap. Soc. Appl. Phys., Suppl.; 43: 49-53(1974).

From 5th international conference on solid state devices; Tokyo, Japan (29 Aug 1973). See CONF-730861–.

The $Ga_{1-x}Al_xAs$ semiconductor laser diodes of double heterostrucutre were fabricated up to $x \approx 0.38$. In order to extend the lasing wavelength to the shortest, doping impurities in the active region were kept to be as low as possible. As a result, the lasing wavelength was extended down to 6200Å at 77°K. Moreover, by making the active region width very narrow, the threshold current density was so reduced that the lasing wavelength of 6930Å was attained at room temperature. The threshold current densities for these shortest lasing wavelength were as low as 300A/cm^2 and 5000A/cm^2 at 77°K and 300°K, respectively. It was also found that the threshold current for visible lasers of double heterostrucutre is a much slower varying function of temperature in comparison with that of single heterostructure. (auth)

20971 HETEROSTRUCTURE CdS_{1-x} Se_x SURFACE LASERS. Kawabe, M.; Kotani, H.; Masuda, K.; Namba, S. (Osaka Univ., Japan). J. Jap. Soc. Appl. Phys., Suppl.; 43: 54-58(1974).

From 5th international conference on solid state devices; Tokyo, Japan (29 Aug 1973). See CONF-730861–.

Optically excited heterostructure CdS_{1-x} Se_x surface lasers which have larger refractive index and smaller band gap than CdS substrate were fabricated on CdS single crystals. The fabrication methods of the heterostructure were solid state diffusion and vapor phase epitaxy. The thickness of the surface layer is 1-3μm and x, the mole fraction of CdSe is 0.01 to 0.25. The laser threshold of the sample grown epitaxially is lower than that of the sample prepared by diffusion by one order of magnitude. The optical confinement in the surface layer was confirmed by near field pattern of the laser. The optical gain of the epitaxially grown surface layer is 58cm^{-1}, on the other hand the gain of CdS and $CdS_{0.76}Se_{0.24}$ single crystals are 44cm^{-1} and 31cm^{-1}, respectively, when measured at the same condition. Intense axially single mode output was observed from the sample which has a stripe geometry mask with a 20μm-slit. The single mode was observed up to the excitation density three times as large as the threshold. (auth)

20972 DEGRADATION OF $Al_xGa_{1-x}As$ DOUBLE HETEROSTRUCUTRE LASERS. Yonezu, H.; Sakuma, I.; Kamejima, T.; Ueno M.; Kobayashi, K.; Nishida, K.; Nannichi, Y.; Hayashi, I. (Nippon Electric Co., Ltd., Kawasaki, Japan). J. Jap. Soc. Appl. Phys., Suppl.; 43: 59-62(1974).

From 5th international conference on solid state devices; Tokyo, Japan (29 Aug 1973). See CONF-730861–.

Degradation of DH lasers by operation was observed during room temperature. DH layers were grown with the conventional LPE technique and diodes mostly had stripe geometry. It was found that the defects which caused the short term ($\leq 10^2$ hours) degradation were localized. The defect is seen as "dark lines" microns to tens of microns long in electroluminescence and in scanning electron microscopy. The dark lines are in the (001) plane of heterojunction, and they are approximately parallel to ⟨100⟩ direction in the plane. Most of the degraded diodes have these dark lines in the high current density area. Decrease in the intensity of electroluminescence, and increase in the threshold current are consistent with appearance of the dark lines where nonradiative recombination predominates. X-ray measurements indicated existence of internal strain at the heterointerface and it is speculated that the strain helped the dark lines to develop under operation. Diodes with an improved LPE growth procedure showed a much slower degradation rate. (auth)

20973 HIGH GAIN STIMULATED EMISSION AND NONLINEAR PHOTOCONDUCTIVITY IN GaSe. Kuroda, N.; Nakanomyo, T.; Nishina, Y. (Tohoku Univ., Sendai, Japan). J. Jap. Soc. Appl. Phys., Suppl.; 43: 63-69(1974).

From 5th international conference on solid state devices; Tokyo, Japan (29 Aug 1973). See CONF-730861–.

The nonlinear photoluminescence and photocurrent response of a layer type semiconductor GaSe were measured at 77° and 4.2°K for the pulsive excitation by the second harmonics (2.34 eV) of the repetitively Q-switched Nd-YAG laser. In weak excitation region the emission spectra show a main peak with its energy close to the direct exciton (2.101 eV). Above the threshold excitation intensity of approximately 1 MW/cm^2, a set of stimulated emission lines appear at photon energies about 50 meV below the direct exciton line. The gain coefficient characteristic curve indicates that the threshold excitation intensity for the stimulated emission is comparable to or substantially lower than GaAs for the same level of impurity concentration. The physical cause of this optical nonlinearity may be attributed to (1) the consecutive emission of two phonons through the intermediate state at the indirect edge and (2) the simultaneous emission of two phonons with small dispersion. (auth)

20974 UNIDIRECTIONAL LASER AMPLIFIER BY HOT ELECTRONS IN SEMICONDUCTOR. Yamanishi, M.; Minami, T.; Kawamura, T. (Univ. of Osaka Perfecture, Osaka, Japan). J. Jap. Soc. Appl. Phys., Suppl.; 43: 70-74(1974).

From 5th international conference on solid state devices; Tokyo, Japan (29 Aug 1973). See CONF-730861–.

A new unidirectional-seminconductor-laser, based on nonsymmetrical distribution of carriers in k-space, is proposed and theoretically analyzed. It is shown that the proposed device, formed by GaAs, has sufficient anisotropic gain in the cases of plane wave and of guided wave. It is discussed that stronger anisotropy of gain may be expected if a higher refractive index can be realized artificially. (auth)

Heat Transfer and Fluid Flow

Refer also to abstracts 20922, 20923, 20925, 21834, 22809, 23109–23122, 23124–23132, 23141, 23187, and 23218.

20975 (EUR-4544) EXPERIMENTAL STUDY OF THE LIQUID FILM IN A TUBE DURING THE EXPULSION OF A BUBBLE. Iovacchini, E. (Commission of the European Communities, Brussels (Belgium). Bureau Euriscotop). 1971. 70p. (In Italian). INIS.

When a vapor bubble expands in a tube and expels the liquid, a layer of the liquid remains attached to the tube wall. The thickness of this layer depends on the physical properties of the liquid, the velocity of the expulsion and the tube diameter. This problem, important for some nuclear reactor safety questions, was studied experimentally and theoretically. In hori-

zontal glass tubes the layer thickness was measured using an optical method with water, cyclohexane, toluene and benzene as test substances. The velocity range was 0 to 22 cm/s. The results are compared with a calculation, based on a balance of viscous forces and surface tension and a correction for the gravitational force. In spite of some neglections in the theoretical formulation (for example the acceleration forces) the agreement between experiment and theory is quite satisfactory. (INIS)

20976 (EUR-4610) CODE FOR PREDICTING THE THERMAL PERFORMANCE OF A ONCE-THROUGH STRAIGHT SHELL-AND-TUBE SODIUM-HEATED GENERATOR. Endrizzi, A.; Baborsky, E. (Commission of the European Communities, Brussels (Belgium)). 1971. 78p. INIS.

Sodium flows on-line, through an unbaffled rod bundle, where the rods are arranged in an equilateral triangular array. Four best transfer regions are allowed for, on the water side, namely: preheat, nucleate boiling, film boiling, and superheat. The choice of the proper correlations is discussed. The tube thickness is evaluated according to the ASME Code. Given the design parameters, a code has been written for calculating the required tube thickness and tube height. Three different arrangements of the steam power plant are considered: (1) once-through single tube; (2) two components: boiler + superheater; and (3) three components: boiler + superheater + reheater. The discussion of the results obtained deals with the influence of steam pressure, in the range $50 <= p <= 170$ kg/cm^2, on the design of the whole plant (both cycle and steam generator). (INIS)

20977 (EUR-5049) CODE TAFEST, NUMERICAL SOLUTION TO TRANSIENT HEAT-CONDUCTION PROBLEMS USING FINITE ELEMENTS IN SPACE AND TIME. Donea, J.; Giuliani, S. (Commission of the European Communities, Brussels (Belgium)). Feb 1974. 42p. INIS.

The computer code TAFEST that has been developed for the purpose of solving two-dimensional transient heat conduction problems is described. The concept of finite elements in space and time is used as a means of obtaining numerical responses. (INIS)

20978 (EUR-5077) DETERMINATION OF THE STEAM CONTENT AND FLOW PATTERN OF A TWO-PHASE MIXTURE IN CONCENTRIC ANNULAR SONDES. Herzberger, P.; Hufschmidt, W. (Commission of the European Communities, Ispra (Italy). Joint Nuclear Research Center). May 1974. 32p. (In Dutch). Dep. NTIS (US Sales Only) $4.75. EUR BF 50.-.

For the quantitative determination of the void fraction of homogeneous two-phase flow (bubble- and mist flow) and qualitative investigation of the flow pattern of non-homogeneous two-phase flow, an annular probe based on impedance measurements was developed. First measurements with a test section with water-air at atmospheric pressure have shown the applicability of the method. (auth)

20979 (NASA-SP-5959(01)) HEAT TRANSFER AND THERMODYNAMICS. A Compilation. (National Aeronautics and Space Administration, Washington, D. C. (USA)). [nd]. 29p. NTIS $1.00.

The National Aeronautics and Space Administration and the Atomic Energy Commission have established a Technology Utilization Program for the dissemination of information on technological developments which have potential utility outside the aerospace and nuclear communities. By encouraging multiple application of the results of their research and development, NASA and AEC earn for the public an increased return on the investment in aerospace and nuclear research and development programs. This document is one of a series intended to disseminate such information. The Compilation is arranged in two sections. Section one presents a group of devices that have been developed to provide more efficient means of heat transfer between components within a system and between systems and the ambient. Additionally, studies on certain theories and mechanical considerations in the transfer of heat are covered. The second section includes various items involved in the thermodynamic properties of matter and the causes and effects of certain interactions. (TFD)

20980 (NP-20071) ANALYSIS OF STEADY-STATE FORCED CONVECTIVE TURBULENT HEAT TRANSFER IN CONCENTRIC ANNULI WITH ARBITRARILY VARYING BOUNDARY CONDITIONS OF SECOND KIND. Gaertner, D. (Technische Univ. Berlin (F. R. Germany). Inst. fuer Kerntechnik). Apr 1974. 247p. (In German). Dep. NTIS (US Sales Only) $15.50.

Thesis.

The problem of turbulent flow heat transfer in concentric annuli is analyzed for the general three-dimensional case in which the wall heat flux varies arbitrarily in both the circumferential and axial directions. The assumptions are those of steady, incompressible, constant-property, fully developed flow of Newtonian fluids in smooth concentric circular annuli. The energy equation is solved using the classical method of superposition and separating variables, where the resulting Sturm-Liouville problem is evaluated numerically. Asymptotic expansions have been developed to determine the higher eigenvalues and eigenfunctions. The solution is based on velocity profiles and anisotropic thermal turbulent transport properties evaluated by Ramm's phenomenological turbulence model which are in excellent agreement with recent experimental data over a wide range of Reynolds number and Prandtl number. Solutions include the limiting cases with respect to channel geometry (circular tube, plane duct) as well as Reynolds-number (laminar flow, slug flow). Results in terms of temperature distributions and Nusselt number are presented in graphical and numerical form and cover a wide range of Reynolds number ($10^4 \leq Re \leq 10^6$) and Prandtl number ($0 \leq Pr \leq 100$). Extensive comparison with experimental results is performed for the following boundary conditions: thermally fully developed situation (heat flux independent of axial direction) at circumferentially both constant and varying heat flux; and entrance heat transfer at circumferentially constant and axially both constant and varying heat flux. Very satisfactory agreement was found at both low and high Prandtl numbers. The effect of a spacially varying heat flux distribution on temperature distribution is demonstrated. (auth)

20981 (PB-228096/4) CAVITATION THRESHOLD AND SUPERHEAT IN VARIOUS FLUIDS. Hammitt, F. G.; Keller, A.; Ahmed, O. S. M.; Pyun, J. J.; Yilmaz, E. (Michigan Univ., Ann Arbor (USA)). Jan 1974. 34p. NTIS $4.75.

Comparisons are made between cavitation thresholds in sodium (and other liquid metals) and water in identical machines, particularly pumps. In all cases where such measurements have been made, it is generally concluded that there is little significant difference between these liquids in regard to cavitation threshold from an engineering viewpoint. However, there is much data scatter in all fluids, which becomes important in certain special cases, e.g., sodium superheat for sodium-cooled fast breeder reactors. It is concluded that the scatter can only be resolved, and further progress made, if detailed measurements of entrained gas nuclei (which are the presumed source of cavitation bubbles) be made for all fluids concerned. This is within the state-of-the-art now for water, but not as yet for sodium. (auth)

20982 (RT/ING-73-6) ANALYSIS OF FACTORS INFLUENCING THE SUPERHEAT ON THE BASIS OF THE EXPERIMENTAL DATA. Scarano, G.; Iannuzzo, P.; Pezzilli, M. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1973. 7p. (RVI-PEC-718). INIS.

From meeting of Liquid Metal Boiling Working Group; Karlsruhe, F. R. Germany (6 Nov 1972).

An analysis of experimental results available in literature on forced convection liquid-metal superheat is described in order to study the influence of the velocity on the superheat. (INIS)

20983 (RT/ING-(74)7) BURN-OUT CORRELATION TO SCALE WATER WITH FREON. Cumo, M.; Maciuca, C.; Moronesi, M.; Palazzi, G. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). Feb 1974. 65p. Dep. NTIS (US Sales Only) $6.25.

A burnout correlation for simple geometries, particularly for once-through tubular steam generators with high L/D ratios, has been tested against experimental data, both for water and Freon 12. Such a correlation, together with the scaling laws, enables the reproduction, in scaled experimental set-ups, of water burnout tests with Freon. The correlation, suggested by M. Silvestri, has the following form: $X_{B.O.} = [1/1 + (C/L_b)^K]$. The deduced relationships of the parameters C and K, as well as scalar function for the specific mass flowrates and surface heat fluxes, are reported. (auth)

20984 (SLL-74-0242) NUMERICAL STUDY OF NATURAL CONVECTION INSIDE A HORIZONTAL CYLINDER WITH ASYMMETRIC BOUNDARY CONDITIONS. Koe, R. J. (Sandia Labs., Livermore, Calif. (USA)). Jul 1974. Contract AT(29-1)-789. 250p. Dep. NTIS $15.50.

Three numerical techniques are developed to predict the two-dimensional, transient, natural convection heat transfer within a horizontal cylinder. The techniques are explicit, ADI, and a new technique which is a hybrid between ADI and explicit. The hybrid method is found to be very much faster than the more conventional methods. All methods solve the full momentum (Navier-Stokes) and thermal energy equations in the stream function-vorticity framework. Unlike previous work, the present methods accom-

modate completely arbitrary temperature boundary conditions. The present techniques do not require that the problem be in an annulus or that it be symmetric so that solution can be done on a half cylinder. Both a limiting form and a Cartesian form of the governing equations are developed and compared for treating the point r = 0 where the polar coordinate equations become singular. The Cartesian form is found to be the superior. Also, considered are the differences resulting from using the constant property equations and the variable property equations. Both solutions are compared to the data of Martini and Churchill (1960). Additionally, constant property solutions are shown to be in excellent agreement with the steady state data of Zimin (1972) and the transient data of Erb (1965) and Hauf and Grigull (1970). (auth)

20985 (UJV-3153-R) EXPERIMENTAL RESEARCH OF LOCAL HYDRODYNAMIC CONDITIONS IN FLAT CHANNELS WITH LONGITUDINAL FINS. II. Malak, J.; Hejna, J.; Cervenka, J.; Mantlik, F. (Ustav Jaderneho Vyzkumu, Rez (Czechoslovakia)). Feb 1974. 68p. (In Czech). Dep. NTIS (US Sales Only) $6.50.

Experimental investigations of velocity fields and wall shear stress distribution at the developed turbulent flow in noncircular channels are described. Experiments were performed on longitudinally finned flat channels. This type of channel represents one of the most complicated geometries that occurs in practice. The arrangement of the experiment and the need for the experimental technique is described in report UJV 2814-R. In this report, the main results in comprehensive form are presented. Attention has been particularly paid to: (1) the velocity distribution along normals to the wetted perimeter and to the question of validity of universal logarithmic distribution, (2) wall shear stress distribution, (3) the existence of secondary flow and its influence on velocity field and wall shear stress distribution, and (4) pressure losses. To make possible the comparison, the report is completed with the results of calculations of velocity fields and wall shear stress distributions for laminar flow. (auth)

20986 HEAT TRANSFER IN LIQUID METALS. Proceedings of a Conference Held at Trogir, Yugoslavia, September 6–11, 1971. Dwyer, O. E. (ed.). Progr. Heat Mass Transfer; 7: 1-588(1973).

Forty-one papers were presented. A separate abstract was prepared for each of 32 papers. For abstracts of the remaining 10 papers see CONF-710942 in the Report Number Index. (LCL)

For abstracts of individual papers see: 20987–21007 and 23109–23119.

20987 SODIUM EDDY DIFFUSIVITY OF HEAT MEASUREMENTS IN A CIRCULAR DUCT. Sheriff, N.; O'Kane, D. J. (United Kingdom Atomic Energy Authority Reactor Group, Risley, Eng.). Progr. Heat Mass Transfer; 7: 25-38(1973).

From international seminar on liquid-metal heat transfer; Trogir, Yugoslavia (6 Sep 1971).

Measurements have been made of the eddy diffusivity of heat in a circular duct with turbulent sodium flow. The conventional method of making such measurements is to take temperature traverses across the fluid stream with a uniform heat flux at the duct wall. For measurements in the central region of the duct this method has several disadvantages, therefore, a different technique was used in the present study. The method used involves the injection of a point source of heat coaxially with the center line of the duct and temperature traverses downstream of the source. From the temperature measurements the total diffusivity is evaluated and hence the eddy contribution can be calculated. The development of the technique is described and values of total diffusivity measured at a Reynolds number of 8×10^4 are given in detail. A value for the ratio ϵ_H/ϵ_M is evaluated. (auth)

20988 MEASUREMENT OF EDDY CONDUCTIVITY IN SODIUM. Fuchs, H.; Faesch, S. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen, Switzerland). Progr. Heat Mass Transfer; 7: 39-43(1973).

From international seminar on liquid-metal heat transfer; Trogir, Yugoslavia (6 Sep 1971).

Temperature profiles in an electrically heated vertical tube were measured in the Pe range 50 to 1000 (Pr ≈ 0.007). Care was taken to minimize buoyancy effects. The eddy conductivity ϵ_H was derived by fitting polynomials to the profiles. Preliminary values for ϵ_H and ϵ_H/ϵ_M (ϵ_M based on the Reichardt expression) are given and compared with earlier measurements. (auth)

20989 RADIAL AND TANGENTIAL TURBULENT DIFFUSIVITIES OF HEAT AND MOMENTUM TRANSFER IN LIQUID METALS. Ramm, H.; Johannsen, K. (Technische Univ., Berlin).

From international seminar on liquid-metal heat transfer; Trogir, Yugoslavia (6 Sep 1971).

An analytical study of eddy diffusivities in both radial and tangential direction for heat and momentum transfer in liquid metals flowing turbulently through smooth plane, circular and concentric annular ducts was carried out. The main theoretical aspects of the analysis are summarized and typical results are presented which are compared with the available experimental data and with previous theoretical predictions. (auth)

20990 MULTIREGIONAL HEAT-TRANSFER ANALYSIS OF LIQUID-METAL FLOW THROUGH ECCENTRIC ANNULI. Wolf, L. (Technische Univ., Berlin). Progr. Heat Mass Transfer; 7: 61-74(1973).

From international seminar on liquid-metal heat transfer; Trogir, Yugoslavia (6 Sep 1971).

An analytical, multiregional solution is presented of the problem of slug-flow heat transfer in an eccentric annulus with constant volume heat release in the internal rod and a thermally insulated outer tube surface obtained by using the point-matching technique in a modified bipolar coordinate system. Typical curves show the effect of eccentricity on the average Nusselt number for various radius ratios and thermal conductivity ratios, demonstrating the influence of additional, circumferential heat conduction in the walls. (auth)

20991 MIXED CONVECTION WITH SODIUM. Wendling, M.; Ricque, R.; Martin, R. (CEN, Grenoble, France). Progr. Heat Mass Transfer; 7: 81-92(1973).

From international seminar on liquid-metal heat transfer; Trogir, Yugoslavia (6 Sep 1971).

Experimental heat transfer results obtained in a vertical asymmetrically heated rectangular channel at low Peclet numbers are presented. The effect of body forces is well correlated with the G^*/Re ratio, and good agreement is found with previously published Russian data. Measurement of transverse temperature profiles shows that a fully developed regime may be defined in the channel. (auth)

20992 EXTENSIONS OF THE HEAT-TRANSFER COEFFICIENT CONCEPT FOR LIQUID-METAL TURBULENT FORCED CONVECTION WITH NONUNIFORM AND TRANSIENT HEAT FLUXES. Stein, R. P. (Argonne National Lab., IL). Progr. Heat Mass Transfer; 7: 93-112(1973).

From international seminar on liquid-metal heat transfer; Trogir, Yugoslavia (6 Sep 1971).

Engineering relationships to account for turbulent forced convection heat transfer in ducts with axially nonuniform and transient heat fluxes and steady flow are discussed. These relationships are suggested as more accurate replacements for the simple heat-transfer coefficient expression $t_s - \bar{t} = q/h$ currently used in most engineering computations involving transients. The new relationships have the form $t_s - \bar{t} = q/h + (D_2/2k)(R_1/\beta)[(\partial q/\partial l) + (1/\mu)(\partial q/\partial r)] + \ldots$ where R_1 and β are dimensionless coefficients which depend on Reynolds and Prandtl numbers and on duct shape. Tabulated values of these coefficients for the circular tube, parallel plane duct, and pin bundle are given over wide ranges of Reynolds and Prandtl numbers with emphasis on liquid metals. The equation given above is a specialized version of a more general expression. The source of this more general expression, the approximations upon which it is based, and its potential utility for practical engineering computations with liquid metals are described. (auth)

20993 EXPERIMENTAL STUDY OF HEAT TRANSFER TO LIQUID METALS FLOWING IN-LINE THROUGH TUBE BUNDLES. Graeber, H.; Rieger, M. (EURATOM-CCR, Ispra, Italy). Progr. Heat Mass Transfer; 7: 151-166(1973).

From international seminar on liquid-metal heat transfer; Trogir, Yugoslavia (6 Sep 1971).

Nusselt numbers for the sodium-potassium alloy NaK (44/56) were obtained in the Peclet range Pe = 110 . . .4300 for the three pitch-to-diameter ratios p/d = 1.25-1.60-1.95 with two test sections each, one being built as a heater with electrically heated tubes and the other as a heat exchanger in a "figure-8" loop. Thirty-one tubes of d = 12 mm o.d. were arranged in an equilateral triangular lattice. Both the wall temperatures of the tubes and the fluid temperatures in the centers of the subchannels were measured by means of about eighty thermocouples per test section. The experimental results for constant heat flux satisfy the relation $Nu = a + b\,Pe^c$, where the constants a = 0.25 + 6.20 p/d, b = − 0.007 + 0.032 p/d, c = 0.800 − 0.24 p/d. (auth)

20994 ASPECTS OF LIQUID-METAL SUPERHEAT AND THE EFFECTS ON DYNAMIC BOILING. Schultheiss, G. F. (Kernforschungsanlage, Juelich GmbH, Ger.). Progr. Heat Mass Transfer; 7: 279-298(1973).

From international seminar on liquid-metal heat transfer; Trogir, Yugoslavia (6 Sep 1971).

The technical background of liquid-metal superheat investigations is briefly given as an introduction. The term "superheat",

which may have many different meanings, is explained in more detail. Problems of incipient boiling superheat are discussed in detail. The thermohydraulic and physico-chemical influences on initial nucleation of vapour bubbles are reviewed. Then nucleation models based on experimental results are discussed. Because of its basic influence, the results of superheat investigations are related to dynamic boiling problems. Finally, some goals of further work on incipient boiling superheat are proposed. (auth)

20995 MECHANISM OF NUCLEATION, SUPERHEATING, AND REDUCING EFFECTS ON THE ACTIVATION ENERGY OF NUCLEATION. Kottowski, H. M. (EURATOM-CCR, Ispra, Italy). Progr. Heat Mass Transfer; 7: 299-324(1973).

From international seminar on liquid-metal heat transfer; Trogir, Yugoslavia (6 Sep 1971).

Nucleation can arise in two ways. The so-called thermal or homogeneous nucleation and athermal or inhomogeneous nucleation. In the case of the homogeneous nucleation the nucleus arises by local statistical entropy fluctuation, which brings together a number of molecules of high thermal energy to form an aggregate of critical size. The inhomogeneous nucleation, however, presumes the presence of latent nuclei, like cavities in the wall or impurities in the liquid. A nucleation model is discussed which is able to describe the large variation in measured superheat data in sodium, as well as the nucleation mechanism, without the assumption of gas pockets or vapour as nucleation sites. (auth)

20996 RANDOM-WALK THEORY OF THE INCEPTION OF BUBBLE GROWTH IN FLOWING LIQUID METALS AT A HEATED WALL. Bankoff, S. G. (Northwestern Univ., Evanston, IL). Progr. Heat Mass Transfer; 7: 325-335(1973).

From international seminar on liquid-metal heat transfer; Trogir, Yugoslavia (6 Sep 1971).

It has been reported that the wall superheat for incipient boiling in a circulating liquid-metal system decreases markedly with increasing bulk velocity, possibly due to the influence of turbulent pressure fluctuations at the mouth of the wall cavity. A random-walk theory is developed to determine the expected waiting time between successive bubbles in a circulating liquid-metal system as a function of wall superheat and bulk velocity. For waiting times in the range of from 0.033 to 0.1 (which correspond to the usual bubbling frequencies) and turbulent intensities of from 0.05 to 0.3, the predicted velocities are almost an order of magnitude greater than the experimental ones for a given percentage decrease in wall superheat at incipient boiling of potassium. It is concluded that other effects are probably more significant in determining the observed results. (auth)

20997 BOILING OF MERCURY IN A VERTICAL TUBE UNDER FORCED-FLOW CONDITIONS. Schmuecker, H.; Grigull, U. (Technische Univ., Hanover). Progr. Heat Mass Transfer; 7: 363-376(1973).

From international seminar on liquid-metal heat transfer; Trogir, Yugoslavia (6 Sep 1971).

The hydrodynamic and boiling behavior of pure mercury in a vertical tube at low exit pressures was investigated. Stable and unstable operating modes were found. At the tube exit, maximum mass flow rate was always established. Heat transfer rates in the non-wetting system are in the range of the values obtained for mercury vapor cooling by forced convection. Visualization of the boiling zone and mercury two-phase flow was obtained by x-ray photography. No similarity to well-known flow patterns was found. (auth)

20998 BOILING WITH LIQUID POTASSIUM IN SHORT ROD BUNDLES. Hoffman, H. W.; Huntley, W. R. (Oak Ridge National Lab., TN). Progr. Heat Mass Transfer; 7: 393-405(1973).

From international seminar on liquid-metal heat transfer; Trogir, Yugoslavia (6 Sep 1971).

Results are presented from experiments to determine the critical heat flux with boiling potassium in upward forced flow in short, finite-array, rod bundles. The 30.5-cm-heated length test boiler was formed of seven 1.27-cm-OD heater elements arranged in triangular pattern at 20-mm separation within a heated shell contoured to simulate the next outer rod ring. Data obtained with two geometrically similar boilers at exit temperatures of from 1033 to 1106°K showed critical fluxes of 132,500 to 268,000 W/m^2 with exit qualities of 58 to 93%. The effects of inlet subcooling, system pressure, shell heating, and central-rod excess heating on ϕ_{crit} were also investigated. (auth)

20999 EXPERIMENTAL INVESTIGATION OF DRYOUT FOR SODIUM BOILING IN NARROW CHANNELS. Peppler, W. (Kernforschungszentrum, Karlsruhe, Ger.). Progr. Heat Mass Transfer; 7: 417-428(1973).

From international seminar on liquid-metal heat transfer; Trogir, Yugoslavia (6 Sep 1971).

To establish the critical conditions that lead to the onset of dry out (DO), sodium boiling experiments were executed in an inductively heated test section. The hydraulic as well as the thermodynamic behaviour of a fuel element subchannel was simulated. The heat flux was varied between 100 to 300 W/cm^2. The tests resulted in the determination of three different initial conditions for the onset of dry out. The first condition exists if, starting from stationary two-phase flow, the sodium film dries off locally. This type of dry out compares well with that observed in two-phase water flow. The other starting conditions are shown to be strongly interconnected with the stability characteristics of the boiling channel and the additional influence of incipient-boiling superheat. (auth)

21000 CRITICAL-FLOW EXPERIMENTS IN A FORCED-CONVECTION BOILING-SODIUM LOOP. Costa, J.; Charlety, P. (CEN, Grenoble, France). Progr. Heat Mass Transfer; 7: 429-439(1973).

From international seminar on liquid-metal heat transfer; Trogir, Yugoslavia (6 Sep 1971).

Consequences of critical flows occurring in a flashing facility and in a forced-convection-boiling loop are presented. A method is derived to determine if critical conditions are reached at the exit of a boiling test section in a forced-convection loop. The method has been tested on a boiling-sodium loop and critical flow rates data are presented. (auth)

21001 HYDRODYNAMIC INSTABILITY IN PARALLEL CHANNELS WITH SODIUM TWO-PHASE FLOW. Peppler, W.; Schleisiek, K. (Kernforschungszentrum, Karlsruhe, Ger.). Progr. Heat Mass Transfer; 7: 441-449(1973).

From international seminar on liquid-metal heat transfer; Trogir, Yugoslavia (6 Sep 1971).

The pressure drop of sodium two-phase flow was measured with two test sections of 4- and 9-mm hydraulic diameters. The results were compared with pressure-drop calculations using Chen's correlation for the liquid fraction as a function of the Lockhart-Martinelli parameter and Levy's model for the dependence of the two-phase pressure drop multiplier on the liquid fraction. The results agree rather well in the low-quality region, but less in the region above 0.15. The measured and calculated two-phase pressure-drop results formed the basis for a description of the hydrodynamic instability behaviour of parallel channels. (auth)

21002 TRANSIENT LIQUID-METAL BOILING AND TWO-PHASE FLOW. Fauske, H. K. (Argonne National Lab., IL). Progr. Heat Mass Transfer; 7: 451-465(1973).

From international seminar on liquid-metal heat transfer; Trogir, Yugoslavia (6 Sep 1971).

Experimental data indicate that transient liquid-metal boiling in narrow ducts is best characterized by the "slug-annular" flow regime; the early void growth being described by the usual slug flow approximation (uniform pressure within the bubble), while the annular flow condition (non-uniform pressure within the bubble) describes the later stages of voiding. Simple methods for estimating the incipient superheat, the spherical and cylindrical vapor growth, the liquid film thickness, the transition from slug to annular flow, and the occurrence of local dryout are discussed. (auth)

21003 EXPERIMENTAL STUDY OF NATURAL CONVECTION HEAT TRANSFER FROM VERTICAL FLAT PLATES IN MERCURY. White, D. H.; Welty, J. R.; Hurt, J. C. (Oregon State Univ., Corvallis). Progr. Heat Mass Transfer; 7: 485-501 (1973).

From international seminar on liquid-metal heat transfer; Trogir, Yugoslavia (6 Sep 1971).

Velocity and temperature profiles adjacent to a constant heat flux, vertical flat plate within a pool of liquid mercury have been measured and compared with integral, similarity, and perturbation solutions. In addition, an empirical heat-transfer equation is presented. Trends and comparisons indicate: that no available heat-transfer analytical result matches the experimental data; that velocity and temperature profiles are functions of both the modified Grashof number and the location along the plate, a result predicted by perturbation solutions but not by integral or similarity solutions; and that the empirical equation suggests higher heat transfer than earlier correlations predict. (auth)

21004 MIXED CONVECTION IN THE SHELL OF A HORIZONTAL Na-to-NaK HEAT EXCHANGER. Skupinski, E. (EURATOM, Brussels). Progr. Heat Mass Transfer; 7: 527-537(1973).

From international seminar on liquid-metal heat transfer; Trogir, Yugoslavia (6 Sep 1971).

Experimental results are presented, obtained on a Na-to-NaK heat exchanger operated in the from 88-to-1500 Peclet number range. For the present test section, operating in the horizontal position (equivalent diameter $D_H = 7.24 \times 10^{-2}$ m), an important influence of free convection has been observed at Peclet numbers lower than 800. The effect is characterized by a noticeable sodium stratification, with temperature differences on the shell in some cases of nearly 90°C, and by a decrease in the average heat-exchange rate, although locally, for a value of $L/D_H = 68.5$, Nusselt numbers are higher than forced-convection values. The temperature distributions of the sodium on the shell-side are shown, and the shell-side mixed-convection Nusselt numbers are compared with those for forced convection. (auth)

21005 THEORETICAL INVESTIGATION OF NON-EQUILIBRIUM FLOW OF VAPORIZING POTASSIUM THROUGH A CONVERGENT-DIVERGENT NOZZLE. Staedtke, H. (Technische Univ., Berlin). Progr. Heat Mass Transfer; 7: 539-552 (1973).

From international seminar on liquid-metal heat transfer; Trogir, Yugoslavia (6 Sep 1971).

With the flow of one-component, two-phase mixtures with low vapour qualities through convergent-divergent nozzles, there is very rapid expansion and evaporation, and considerable deviations from the equilibrium state can occur. The extents of these deviations are determined by the exchange processes of mass, momentum and heat. A complete set of equations is given for describing this phenomenon. The emphasis lies in the investigation of the exchange processes between the continuous gas phase and the dispersed liquid phase. Numerical evaluations are given for potassium and for water. The following are calculated for the expansion process: vapour quality, temperatures of vapour and liquid phases, their deviations from the saturation temperature and the different velocities of both phases (slip). (auth)

21006 HEAT TRANSFER IN TURBULENT FLOW OF LIQUID METALS IN A MAGNETIC FIELD. Petukhov, B. S.; Zhilin, V. G. (Moscow Inst. of High Temperature). Progr. Heat Mass Transfer; 7: 553-568(1973).

From international seminar on liquid-metal heat transfer; Trogir, Yugoslavia (6 Sep 1971).

It is stated that the study of turbulent MHD flow in liquid metals, and heat transfer in such flows, is of practical importance in connection with the design of electromagnetic pumps, MHD generators and other MHD devices. Available results are reviewed. The discussion falls under the following headings: general description of the problem; velocity profiles and turbulent diffusivity coefficients for flow in tubes (longitudinal magnetic field, transverse magnetic field); heat transfer for flow in tubes (longitudinal magnetic field, transverse magnetic field); and problems for further research. (UK)

21007 CURRENT LIQUID-METAL HEAT TRANSFER RESEARCH IN JAPAN. Aoki, S. (Tokyo Inst. of Tech.). Progr. Heat Mass Transfer; 7: 569-587(1973).

From international seminar on liquid-metal heat transfer; Trogir, Yugoslavia (6 Sep 1971).

For the purpose of developing liquid-metal-cooled fast reactors, many investigations have been carried out in Japan. In the matter of convective heat transfer, eddy diffusivities for heat and momentum transfers were studied and applied to the correlation of heat-transfer coefficients for sodium. The heat-transfer coefficients were measured for both uniform and sinusoidal axial heat flux shapes. in the case of boiling heat transfer, boiling curve, bubble growth velocity for mercury, the influence of dissolved gas on the incipient-boiling superheat and the power spectrum of pressure fluctuation for sodium convective boiling have been investigated. (auth)

21008 SOME METHODS AND MEASUREMENT EQUIPMENT FOR THE STATISTICAL PROCESSING OF DATA. Michkal, A.; Lishka, I. pp 82-103 of Modelirovanie Termodinamicheskikh Yavlenii v Aktivnoi Zone Bystrykhreaktorov. Prague; Czechoslovak Atomic Energy Commission (1971). (In Russian)

From international conference on simulation techniques in the investigation of thermokinetic effects in the core of fast reactors; Domazlice, Czechoslovakia (23 Feb 1970). CONF-700230-.

The basic characteristics of random processes and the possibilities for their measurement, processing, and classification at the Skoda plant are discussed. The question concerns particularly those random processes whose frequency range corresponds with that of normal processes involving thermomechanics and heat exchange. Equipment which can serve in a universal measurement system is described. As an example of the application of this system in reactor techniques, a brief description is given of the control of welding processes, measurement of turbulent heat transfer, measurement of time of passage of gases or liquids through an object under study, a method for the indication of weak periodic signals, and the effect of motion pulsation. (tr-auth)

21009 SOME OPTICAL CHARACTERISTICS OF SPHERICAL VAPOUR BUBBLES IN LIQUIDS. Hooper, R. C.; Uzunovic, R. I. (Univ. of Toronto). pp 31-38 of Optical Instrumentation Engineering in Science, Technology, and Society. Katz, Y. H. (ed.). Redondo Beach, CA; Society of Photo-Optical Instrumentation Engineers (1973).

From proceedings of the Society of Photo-Optical Instrumentation Engineers; San Mateo, California, USA (16 Oct 1972). See CONF-721032-.

Ultrahigh-speed photographic apparatus, developed for studying the mechanisms involved in the flashing of superheated liquids, specifically the growth of individual bubbles, was used to explain the optics of the center eye and bright annular ring observed in spherical bubbles. It was found that the position of the annular ring is a function of the refractory index and, therefore, a function of the temperature, but that this effect is too weak to be useful in diagnostic work in the flashing of water vapor. In other fluids it may prove useful. (LCL)

21010 INCIPIENT BOILING OF SODIUM FLOWING IN A SINGLE-PIN ANNULAR CHANNEL. Kikuchi, Y.; Takahashi, T.; Haga, K.; Okouchi, T. (Power Reactor and Nuclear Fuel Development Corp., Oarai, Japan). J. Nucl. Sci. Technol. (Tokyo); 11: No. 5, 172-186(May 1974).

An experimental study on incipient boiling of sodium flowing in an annular channel electrically heated by a pin forming the channel core is discussed. In the present experiment, the inlet temperature and flow rate were held constant, and the heat flux was gradually increased up to inception of boiling. Measurements were made of the incipient boiling superheat, and the boiling patterns were observed. The experimental results were compared with analytical calculations. The incipient boiling wall superheat decreased exponentially with increase in flow rate. The boiling patterns observed in the present experiment were not the single-bubble slug expulsion model, as assumed in calculational code, but more similar to multiple-bubble slug expulsion or homogeneous two-phase flow models. (auth)

21011 HIGH SPEED TWO-PHASE FLOW. III. Theory on Critical Flow in Constant-flow-area Channel. Adachi, H. (Japan Atomic Energy Research Inst., Tokai). Nippon Genshiryoku Gakkaishi; 16: No. 5, 282-288(May 1974). (In Japanese).

A description is given of results obtained on the application of the general theory of high-speed two-phase flow to a critical discharge flow through a constant flow-area channel. In this case, the flow cannot be satisfactorily expressed without considering pipe friction, because this constitutes the sole factor that changes the flow in the axial direction. It is shown that when the stagnant pressure and the stagnant steam quality in a high-pressure reservoir are given, two-phase flow parameters such as steam quality, the linear velocities of steam and water, slip ratio and void fraction at any point along the channel can be derived from the pressure prevailing at the given point. It is also demonstrated that two-phase critical flow can be defined as a flow in which the integrated frictional pressure loss reaches a limit and can increase no further. Moreover, if the channel characteristics in respect of two-phase frictional pressure loss are known, the above-mentioned two-phase flow parameters can be determined as function of the position along the channel. Numerical calculations show that the critical pressure obtained with this theory agrees well with experimental results. At the same time it has been found that the frictional pressure loss of violently flashing two-phase flow is markedly higher than the value predicted by some of the current correlations derived for other kinds of flow. (auth)

21012 INVESTIGATING THE SURFACE TENSION OF H_2O AND D_2O AT NEAR-CRITICAL TEMPERATURES. Vargaftik, N. B.; Volyak, L. D.; Volkov, B. M. (Moscow Aviation Inst.). Therm. Eng. (USSR) (Engl. Transl.); 20: No. 8, 110-113(Aug 1973).

Translated from Teploenergetika; 20: No. 8, 80-82(Aug 1973).

Measurements of the surface tension of H_2O at temperatures from 0.4 to 370.4°C and of D_2O at temperatures from 16.4 to 368.87°C are described and the results tabulated. The surface tension was determined by the rise of the liquid in a capillary and took into account the temperature dependence of the contact angle. (LCL)

21013 INVESTIGATING THE POSSIBILITY OF USING HOLOGRAPHY IN THE STUDY OF TWO-PHASE FLOWS. Alad'ev, I. T.; Ginsburg, V. M.; Gavrilova, N. D.; Kuznetsova, E. A.; Soluyanov, Yu. F.; Tsarfin, V. Ya. Therm. Eng. (USSR) (Engl. Transl.); 20: No. 8, 90-92(Aug 1973).

Translated from Teploenergetika; 20: No. 8, 66-68(Aug 1973).

Two-beam holography with an inclined reference beam was used to obtain instantaneous 3-dimensional images of a section of non-steady two-phase flow and to measure the droplet distribution with respect to dimensions in this section of the flow. Pictures of the gas pressure distributions in the core of the flow and a profile of the wall-adjacent layer were also obtained. From these experiments it was concluded that: two-beam holography with lateral illumination allows one to obtain qualitative images with the reconstruction of holograms of three-dimensional nonuniformities in two-phase flows, and also to obtain interferograms of the gaseous phase of disperse-annular flows; and using the above apparatus it is possible to determine the distribution of droplets from 10 to 200 μm in size in a space of 0.5 to 100 cm^3 and to measure the velocity of the individual droplets in a range up to 50 m/s. (LCL)

21014 USING A VENTURI TUBE TO MEASURE THE CONCENTRATION OF THE LIQUID PHASE IN THE CASE OF FLOW OF A TWO-COMPONENT MIXTURE. Alekseev, A. V.; Kazanskii, A. M.; Minailenko, A. E. (Kalinin Polytechnical Inst., USSR). Therm. Eng. (USSR) (Engl. Transl.); 20: No. 8, 86-89(Aug 1973).

Translated from Teploenergetika; 20: No. 8, 63-65(Aug 1973).

The gasdynamic method of measuring the concentration of the liquid phase in a flow of a two-component mixture which is based upon the dependence of the drop in the static pressures on the flow concentration of the liquid phase y in various throttling units is examined, and a method of designing and constructing gasdynamic sensitive elements, in particular a probe for measuring the amount of moisture in the air in the cycle of gas turbine installations is described. Laboratory tests of the probe were carried out in an air-water flow at atmospheric pressure, an air temperature of 30 to 40°C, a range of flow velocities of 49 to 74 m/s and concentrations of atomized water in the flow from 0 to 6%. The results of the experiments showed that using the probe as a sensitive element of a measuring instrument for liquid concentration ensures reliable moisture concentration measurements in a flow of moistened air, with an accuracy to within ±20% of y. (LCL)

21015 EXPERIMENTAL INVESTIGATION OF THE SPECIFIC VOLUMES OF HEAVY WATER IN THE 200 TO 425°C TEMPERATURE RANGE AT PRESSURES UP TO 1000 BAR. Tsederberg, N. V.; Aleksandrov, A. A.; Khasanshin, T. S.; Larkin, D. K. (Moscow Power Inst.). Therm. Eng. (USSR) (Engl. Transl.); 20: No. 8, 17-19(Aug 1973).

Translated from Teploenergetika; 20: No. 8, 13-15(Aug 1973).

The experimental apparatus used for measuring the specific volumes of 99.7% heavy water at different pressure and temperature conditions is described and the results are presented. The results compared favorably with previously obtained data which was limited to pressures up to 300 bar. (LCL)

21016 INTENSITY AND PROPAGATION VELOCITY OF COMPRESSION SHOCK PULSES IN LOW PRESSURE STEAM-WATER MEDIUM. Miyazaki, K.; Fujii-e, Y.; Suita, T. (Osaka Univ., Suita, Japan). J. Nucl. Sci. Technol. (Tokyo); 11: No. 5, 199-207 (May 1974).

Applying stepwise compressive disturbances of only 1.0 bar from 1.5 to 2.5 bar to a steam-water two-phase medium containing an initial void fraction up to 17%, very strong secondary pressure pulses with peaks that could approach 100 bar lasting a few milliseconds were observed to evolve by the impulse of hammer action, in a shock tube type vertical experimental device constituted of a stainless steel pipe of rigid structure, 40 mm inner diameter and about 2.5 m long. The intensity of these secondary shock pulses agreed fairly well with values based on Karplus' theoretical treatment slightly modified. The measured propagation velocity of the primary disturbances showed good agreement with that based on the completely condensed shock wave model proposed by Karplus. Comparing the present results with those obtained in a preliminary experiment, it is concluded that the propagation of the primary shock pulse waves should be distinguished from that of usually considered pressure waves with small amplitude. It is suggested that, from considerations of safety, careful attention should be paid in the design of reactors with a low system pressure, e.g., sodium cooled FBR, to the possibility of such strong secondary pressure pulses being generated by hammer action. Appreciable damage was actually sustained in the experiment by detectors of semiconductor piezo type with 5 mm outer diameter and 10 kg/cm^2 rating. (auth)

21017 HEAT TRANSFER TO A SODIUM–POTASSIUM ALLOY IN THE NUCLEUS OF A DENSE PACKING OF RODS WITH MIXED CONVECTION. Kolyaskin, V. I.; Kudryavtseva, L. K.; Ushakov, P. A. (Physical Energetics Inst., Obninsk, USSR). Int. Chem. Eng.; 14: No. 3, 506-510(Jul 1974).

Translated from Teplofiz. Vys. Temp.; 11: No. 4, 781-787(1973).

Results of an experimental study of heat-transfer rates to a liquid sodium-potassium alloy from a cluster of metal rods, simulated by an assembly of three closely packed, electrically heated copper tubes, are presented. (auth)

Materials Testing

Refer also to abstract 23192.

21018 RADIOGRAPHIC INSPECTION OF THE SOLDERING OF HYDRAULIC TURBINE STATORS. Levenberg, L. I.; Balyuk, F. B. (Experimental Design Isotope Lab., Dnepropetrovsk, USSR). Sov. J. Nondestruct. Test. (Engl. Transl.); 9: No. 5, 599-600(1973).

Translated from Defektoskopiya; 9: No. 5, 109-110(1973).

Severe heating (up to melting) of the stator windings was observed during operation of the hydraulic turbines of the Dneprodzerzhinsk hydroelectric station. This led to an almost 80% decrease of the load. Pyrometric investigations did not reveal the causes of this phenomenon. Therefore, the quality of soldering of the turbine stators was checked by gamma radiography. The method used and the results obtained are reported. (TFD)

21019 ALGORITHM FOR DIGITAL PROCESSING OF RADIOMETRIC INFORMATION ON OBSERVING A SIGNAL WITH AN UNKNOWN TIME OF ARRIVAL. Pokrovskii, A. V.; Selivanov, V. G. (Tomsk Polytechnic Inst., USSR). Sov. J. Nondestruct. Test. (Engl. Transl.); 9: No. 5, 559-562(1973).

Translated from Defektoskopiya; 9: No. 5, 62-67(1973).

A quasioptimal algorithm is considered for digital processing of data from γ-ray flaw detection; this infers detection of a signal with unknown parameters to observation of a determinate signal. The processing method substantially increases the probability of observing the signal from a defect. A method is considered for choosing the optimal parameters for the flaw detector that minimizes the overall error of observation. (auth)

21020 EFFECT OF SCATTERED RADIATION IN GAMMA SCINTILLATION FLAW DETECTION. Efimov, V. F.; Zaklyukovskii, V. I.; Paskevich, A. F. Sov. J. Nondestruct. Test. (Engl. Transl.); 9: No. 5, 554-558(1973).

Translated from Defektoskopiya; 9: No. 5, 56-62(1973).

The effects of scattered radiation are considered as regards the signal-to-noise ratio for various types of recording systems. It is shown that the ordinary analog systems can be used without substantial loss in that ratio if there are numerical buildup factors of 5 to 10, the exact value depending on the spectrum of the scattered radiation. A system is described for an analog recorder with pulse discrimination to isolate the scattered radiation. (auth)

21021 SPATIAL RADIOACTIVE LABELING IN MATERIALS RESEARCH. Popov, S. (Central Heavy Machinery Scientific-Research Inst., Sofia). Sov. J. Nondestruct. Test. Engl. Transl.); 9: No. 5, 616-618(1973).

Translated from Defektoskopiya; 9: No. 5, 123-126(1973).

When a metal is worked by pressure (forging, rolling, etc.) or is under mechanical test, internal spatial displacement of particles can take place. The movement of these particles is very hard to follow by metallographic methods. A method of radioactive labeling for research on such movements is described. The method consists of irradiating the specimen through collimators of different shapes which forms patterns of labeled particles. After deformation has taken place the pattern is examined by autoradiography. (TFD)

21022 NONDESTRUCTIVE TESTING OF SEAM WELDS ON CIRCUMFERENTIAL SEAMS OF PIPES CONSISTING OF POLYETHYLENE HARD (PEh). Herrmann, H. GWF Wasser-Abwasser; 114: No. 8, 370-373(1973). (In German).

9 figs.

Ultrasonic testing and the radiometric method using soft X-rays are the most commonly applied techniques in the nondestructive testing of plastics for the detection of bonding defects, shrinkage cavities and cracks. While the radiometric testing is suitable for all qualities and yields information about most types of defects, the ultrasonic testing method is subject to certain material-dependent restrictions with regard to damping and sound scattering. (GE)

Nuclear Explosions

Refer also to abstracts 21086 and 21176.

21023 (AD-763750) FOREST BLOWDOWN FROM NUCLEAR AIRBLAST. Final Technical Report. Morris, P. J. (URS Re-

search Co., San Mateo, Calif. (USA)). Jul 1973. Contract DNA001-72-C-0021. 97p. (URS-7049-10-Rev-1; DNA-3054F). NTIS $3.00.

A sensitivity analysis is performed on a computer model of tree response to airblast loading. This effort was undertaken, with success, to reduce the number of input parameters required by the model to those available to the field commander. Based on the results of this analysis, a new prediction technique was developed which determines the extent of tree blowdown and the resultant effects on troop and vehicle movement. The technique was developed for inclusion in DNA Effects Manual Number 1. (auth)

21024 (AD-775708/1) TIME DEPENDENT INTERNAL ELECTROMAGNETIC PULSE FOR SPHERICAL AND CYLINDRICAL SYMMETRY. Salvi, T. C. (Air Force Inst. of Tech., Wright-Patterson AFB, Ohio (USA). School of Engineering). Mar 1974. 51p. (GEP/PH-74M-10). NTIS $5.75.

Thesis.

Time varying charge densities and electric fields caused by the symmetric inward emission of electrons are computed for the interior of a hollow sphere and cylinder. The Vlasov equation is derived in spherical and cylindrical coordinates. A quasi-static assumption is made. Electric fields are computed at the end of each time step. Several different methods of obtaining the charge density and field at each time step are discussed, all based on tracing characteristic curves of the Vlasov equation. The simplest of these methods is implemented. The distribution is stored in a discretized phase space, and particles are redistributed to phase points at the end of each time step. A coarse grid is used and numerical techniques are designed so as to expend minimal computer resources. A Maxwellian input distribution is assumed and several sample results are presented. (GRA)

21025 (AD-775754/5) TECTONIC STRAIN RELEASE BY UNDERGROUND NUCLEAR EXPLOSIONS. Final Report, 1 October 1971–30 September 1973. Toksoez, M. N. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Earth and Planetary Sciences). 31 Dec 1974. Contract F19628-72-C-0094. 42p. (AFCRL-TR-74-0015). NTIS $5.25.

Theoretical and observational research has been carried out in order to study tectonic strain. Theoretical calculations for a composite source model consisting of explosive and double couple components were compared to observed surface wave spectral ratios from underground nuclear explosions. A theoretical calculation is presented to explain the observed double couple component associated with tectonic stress release. Results from numerical calculations of induced flow behind island arcs and the associated tectonic stresses are presented. (auth)

21026 (AD-776088/7) RESEARCH IN SEISMOLOGY. Annual Report, 1 April 1972–31 March 1973. Press, F.; Toksoz, M. N.; Aki, K. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Earth and Planetary Sciences). 15 Aug 1973. Contract F44620-71-C-0049. 256p. (AFOSR-TR-74-0356). NTIS $6.50.

A summary of the projects conducted during the last year under the contract research in seismology is presented. These investigations fall roughly under three broad headings: (1) theoretical studies of source mechanisms of earthquakes and underground nuclear explosions; (2) earth structure and path effects, especially the effects of lateral heterogeneities in velocity and in Q; and (3) studies of the capabilities of arrays for event detection and location. Lists of publications and theses completed during the contract year are also included. (auth)

21027 (AD-776089/5) LONG-PERIOD RESULTS FROM THE INTERNATIONAL SEISMIC MONTH. Filson, J. R. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 4 Mar 1974. Contract F19628-70-C-0230. 51p. (ESD-TR-74-44). NTIS $3.75.

Using a list of nearly 1,000 epicenters and a list of some 15,000 concurrent long period detections, an attempt was made to assign reliable surface wave magnitudes (M(S)) to the events through automatic association and magnitude determination routines. An association scheme using an average group velocity curve and a rather wide group velocity association window is ultimately used, though more elaborate schemes, such as one employing path dependent group velocities, are considered. The M(S) determination method of Marshall and Basham is extended to cover wider distance and period ranges in order to make use of very long period detections at high gain stations. Although the routines developed are not yet considered optimum, the long period network used realizes 90% cumulative thresholds of M(S) determination at body wave magnitudes of 5.3 worldwide and 4.6 for shallow events in Asia. (auth)

21028 (LA-5602-MS) CALCULATION OF STEAM FLOW AND HYDRAULIC FRACTURING IN A POROUS MEDIUM WITH THE KRAK CODE. Keller, C. E.; Davis, A. H.; Stewart, J. N. Jr. (Los Alamos Scientific Lab., N. Mex. (USA)). May 1974. Contract W-7405-eng-36. 23p. Dep. NTIS $4.00.

A computer program named KRAK has been developed for calculating the flow of steam and water in a porous medium and also the growth of a crack produced by the high pressure fluid. The program is written for a two-dimensional cylindrically symmetric geometry. The model treats the thermodynamics of the two-phase steam-water system accurately. It also takes into account heat conduction through the porous medium and between the medium and the fluid. Crack growth is treated in a quasi-static approximation, but within this limitation the detailed crack shape is obtained. Darcy flow is assumed within the porous medium, but fluid flow in the crack itself is calculated accurately from the equations for flow between parallel plates for all ranges of the Reynold's number. A suite of illustrative calculations is given showing the dependence of crack growth rates on the main parameters of the problem: source pressure, permeability, porosity, medium saturation, tensile strength, etc. (auth)

21029 (LA-5615-MS) DESIGN CONSIDERATIONS FOR A HIGH-PRESSURE, EQUATION-OF-STATE EXPERIMENT. Ragan, C. E. III. (Los Alamos Scientific Lab., N. Mex. (USA)). May 1974. Contract W-7405-eng-36. 18p. Dep. NTIS $4.00.

Experiments to measure shock velocity and particle velocity at pressures of ~0.8 TPa and ~2.1 TPa were fielded on an event at the Nevada Test Site. A description of the calculations involved in designing the experiment is presented. An underground nuclear explosion was used to produce a large flux of neutrons that were used to rapidly heat a slab of fissionable material. This material then drove a shock into a slab of molybdenum, which was chosen as a standard against which other materials could be calibrated. Basically the shock velocity measurements involved a determination of the transit time of the shock between points known distances apart. The particle velocity measurements involved a determination of the Doppler shift of low-energy neutron resonances for material behind the shock. This measurement was accomplished using time-of-flight (TOF) techniques with low-energy neutrons produced in a moderating material. The basic calculations needed for the design are: Calculations of the neutron transport from the device to the driver material; calculations of the shock strength due to fission heating and its subsequent time history in the shocked material; calculations of the time history of the low-energy neutron flux; and calculations of the Doppler broadening and shifts of the neutron resonances. Preshot calculations of the expected TOF signal for the two experiments are presented. A short discussion of the shot data is also presented. Both the shock velocity and the particle velocity measurements failed to work as expected. In the shock velocity measurement the background was as large as the signal itself, and in the particle velocity measurement a large background and neutrons from an unexpected source obscured the signal. These errors should be easy to correct, and the design considerations presented here should, for the most part, be valid for the next experiment. (auth)

21030 (PNE-MHF-1) RIO BLANCO MASSIVE HYDRAULIC FRACTURE. Project Definition. (CER Geonuclear Corp., Las Vegas, Nev. (USA)). 1973. 99p. Dep. NTIS $8.00.

The Piceance Basin in Colorado contains an estimated 600 trillion ft^3 of natural gas in place. Both the Rulison and Rio Blanco Events have been detonated to determine the feasibility of nuclear fracturing to stimulate natural gas production in this basin. A demonstration program to test the relative effectiveness of massive hydraulic fracturing (MFH) to achieve natural gas production stimulation from the same gas reservoir is presented. Details are included on: MHF design parameters, including surface and subsurface equipment, pumping requirements, evaluation of fracturing results, and all associated test programs; site characteristics and preparation; proposal for gas utilization program; environmental surveillance and comparative analysis of environmental aspects of MHF and nuclear stimulation; gas delivery estimates; project administration; and costs and scheduling. (LCL)

21031 (UCID-15848) PHYSICAL PROPERTIES OF (MOSTLY NORTHERN) YUCCA FLAT ALLUVIUM AND TUFF. Carlson, R. C.; Hearst, J. R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 12 Jul 1971. Contract W-7405-eng-48. 36p. Dep. NTIS $5.00.

In order to perform computer calculations for predicting the effects of underground nuclear explosions in Yucca Flat, the density and the acoustic velocity of the material in which the explosions are fired are required as input. Other properties, if available, help characterize the material. Although two-dimen-

sional computer programs are available, a one-dimensional Lagrangian program such as SOC is normally used for this work. Density and acoustic velocity have been measured in more than 100 holes in Yucca Flat, and the results are stored at LLL. LLL has the ability to publish large amounts of these data in a form that is suitable for comparative examination. A thorough treatment of the data would involve examining each log in detail to verify its accuracy, then producing both a statistical analysis of the average variation of each parameter vs depth and histograms of the frequency of occurrence of various values. However, as a first attempt, only those data that appear to be reliable are presented. The reliability of each kind of data is discussed as it is presented. In only one hole have density, compressional-, and transverse-wave velocities, and water content all been measured well. There are very few holes in which more than one of these properties has been measured well. Only compressional-wave velocity has been measured reasonably well in a fairly large number of holes. (auth)

21032 (UCID-16161) CHIMNEY PERMEABILITY BY ATMOSPHERIC PRESSURE CHANGE: PRELIMINARY PERMEABILITY CALCULATIONS. Snoeberger, D.; Morris, G.; Rozsa, R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 29 Nov 1972. Contract W-7405-eng-48. 16p. Dep. NTIS $4.00.

A preliminary fit between measured and calculated transient gas pressures affected at depth in two older nuclear explosion chimneys by atmospheric pressure changes and flow was made. Darcy flow in a one-dimensional uniform medium was calculated. A range of 25 to 100 darcies for the permeability of the two chimneys in alluvium at the AEC Test Site in Nevada was estimated. (auth)

21033 (UCID-16529) N-COMPONENT EXPLOSIVE SYSTEMS: FEASIBILITY STUDY. Quong, R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 11 Jul 1974. Contract W-7405-eng-48. 15p. Dep. NTIS $4.00.

A fuel/oxidizer system, TATB (triamino-trinitrobenzene) and HAP(ss) (a saturated solution of hydroxyl ammonium perchlorate), was used to evaluate the characteristics of a multicomponent explosive system for weapons program applications. Both the fuel and oxidizer are individually nonexplosive (or extremely insensitive to impact), and as such their use in nuclear weapons systems would minimize the danger of unintentional detonation as long as the components remain separated. A viable explosive is produced only when the components are combined. Techniques used in preparing the explosive and tests conducted to evaluate explosive performance are discussed. The TATB/HAP(ss) system, although considerably deficient in energy, lends itself to much of the developmental aspects of the study due to the relatively innocuous nature of the individual components. Based on some of the work described in this paper, the concept of using a fuel/oxidizer system appears feasible. Energy output is low, but uniform. Higher-energy systems will need to be developed. There is evidence that such systems can be achieved by using oxidizers with greater oxygen density. (auth)

21034 (UCID-16540) SEISMIC PROTECTION OF BURIED STRUCTURES. Blake, A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Sep 1972. Contract W-7405-eng-48. 13p. Dep. NTIS $4.00.

Current and past studies on the seismic design of underground structures were reviewed at a conference of Asilomar, Calif. held Sept. 5 to 10, 1972. From these discussions the majority of the participants concluded that: earthquake environment presents relatively fewer problems to the plant itself than to its life-lines; state-of-the-art knowledge in design is rather elementary, and suitable research, codification and coordination are badly needed; static considerations for underground rooms are satisfactory; it is not feasible to design piping for fault crossing with present level of knowledge; equipment can be designed for most seismic conditions if factors of safety and acceleration levels are not escalated; the majority of pipelines and similar components fail at attachments; any conduit can go underground provided soil conditions are well known; underground nuclear plants should be protected by double containment; esthetics and environment are strong and sometimes the only reasons for undergrounding; if the state-of-the-art knowledge in seismic response of soil masses is not upgraded, future earthfilled dams will not be built; and permanent international organization should be formed to coordinate seismic research and design in relation to underground structures. (LCL)

21035 (UCRL-51560) RIO BLANCO: NUCLEAR OPERATIONS AND CHIMNEY REENTRY. Woodruff, W. R.; Guido, R. S. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 May 1974. Contract W-7405-eng-48. 99p. Dep. NTIS $5.45.

Rio Blanco was the third experiment in the AEC's Plowshare Program to develop technology to stimulate gas production from geologic formations not conducive to production by conventional means. The project was sponsored by CER Geonuclear Corp. with the Lawrence Livermore Laboratory providing the explosives and several technical programs, such as spall measurement. Three nuclear explosives, specifically designed for this application, were detonated simultaneously in a minimum-diameter emplacement well using many commercially available, but established-reliability components. The explosive system performed properly under extreme temperature and pressure conditions. Emplacement and stemming operations were designed with the aim of simplifying both the emplacement and reentry and fully containing the detonation products. An integrated command and control system was used with communication to all three explosives through a single coaxial cable. Reentry and the initial production testing have been completed. To date 98 million standard ft^3 of chimney gas have been produced. (auth)

21036 (USGS-474-145) RESULTS OF EXPLORATION OF BANEBERRY SITE, EARLY 1971. (Geological Survey, Denver, Colo. (USA)). Jul 1974. Contract AT(29-2)-474. 123p. (NTS-235). Dep. NTIS $9.25.

The results of postshot geologic studies by the U. S. Geological Survey at Baneberry (U8d), the nuclear explosion that vented December 18, 1970, in northern Yucca Flat, Nevada Test Site, are presented as a series of short papers by several investigators. Two postshot exploratory holes, several angle holes, ground surveys, and analysis of core samples provided data essential to interpreting geologic effects. Venting at Baneberry was apparently related to high clay and water contents, which resulted in excessive coupling of explosive energy to the surrounding medium, combined with geologically unfavorable fault geometry. The radioactive gases and debris escaped from the shot cavity along the large adjacent Baneberry fault — the gases ascending to an intersection with a tension fracture that formed the venting fissure at the surface. Geophysical and infrared surveys corroborate and supplement the structural configuration based on geologic mapping of surface fractures and subsurface information from drill holes. Analysis of motion-picture photography of the Baneberry event combined with detailed surface observations after the event reconstructs the following historical sequence: both the Baneberry fault and the vent fissure formed within 2 seconds after shot time; the vent fissure formed a fraction of a second after the fault. Venting, however, did not begin until about 3.5 minutes after the shot time. The Baneberry sink, 227 feet in average radius and 75 feet deep, subsided about 16.5 minutes after shot time or about 13 minutes after venting had begun. A day after venting had completely ceased, the fissue was visibly open to a depth of about 30 feet and dipped 80°-85° northwest; the main part was open as much as 10 feet just southeast of the sink, but this opening was due to slumping as well as to distension. The northerly trending Baneberry fault, 600 feet west of GZ, has as much as 2-feet vertical displacement down toward the east (GZ) side and, along with other surface cracks, seemingly occurred at the time of cavity collapse. The fact that venting did not cease at the time of chimney collapse indicates that a subsidiary reservoir of hot cavity gases existed adjacent to the main explosion cavity and persisted along after collapse until the subsidiary reservoir was effectively exhausted by venting to the surface. Similarly, the conduit from the subsidiary reservoir must have been at least partly outside the collapse zone to have provided a vent path after collapse; the postshot drilling data and structural interpretation corroborate this conclusion. (auth)

21037 (USGS-474-174) STRAIN MEASUREMENT RESULTS FROM FOUR UNDERGROUND NUCLEAR EXPLOSIONS IN YUCCA AND FRENCHMAN FLATS, NEVADA. Dickey, D. D.; Hassemer, J. H. (Geological Survey, Denver, Colo. (USA)). Jun 1974. Contract AT(29-2)-474. 62p. (NTS-250). Dep. NTIS $6.25.

Over a period of 1 year, three low and one low-intermediate-yield underground explosions in Yucca and Frenchman Flats were measured geodetically for strain. Networks of stations on the ground surface surrounding each explosion were established and distances between them measured before and after the explosion with a model 6 Geodimeter. Strains calculated from these measurements for the largest of the four explosions are in fair agreement with what is predicted for strain in a homogeneous medium. The strains across a major fault from this largest explosion appear to have been modified because of their location. Strains calculated for the other, smaller, explosions deviated more from the pattern expected simply from the effects of an explosion; these variations are attributed to local differences in rock properties and in the natural stress field of the earth's crust. Other evidence of these variations is found in the fracture patterns formed, shape of the sink formed at collapse, and pattern of elevation changes.

Data from the measurements may give an indication of the magnitude of the inhomogeneities in the upper skin of the earth's crust in the Yucca and Frenchman Flat areas. (auth)

21038 (USGS-474-180) ASYMMETRY OF COLLAPSE SINKS IN YUCCA FLAT, NEVADA TEST SITE, NEVADA. Ellis, W. L.; Snyder, R. P. (Geological Survey, Denver, Colo. (USA)). Jun 1974. Contract AT(29-1)-474. 22p. (NTS-243). Dep. NTIS $4.25.

The majority of collapse sinks formed above underground nuclear explosions in Yucca Flat, Nevada Test Site, are elongate in shape when observed in plan view. The ratios of lengths of major to monor sink axes, and the directions of major to minor sink axes, and the directions of major axes of 194 collapse sinks were measured from aerial photographs. The results indicate a preferred northeast–southwest direction of alinement for the major axes of sinks formed above explosions detonated in bedrock. This preferred direction of alinement was not evident for sinks formed above explosions detonated in alluvium, except for the few sinks having a major-to-minor axes ratio of 1.2 or greater. (auth)

21039 YADERNYI VZRYV V KOSMOSE, NA ZEMLE I POD ZEMLEI. Elektromagnitnyi Impul's Yadernogo Vzryva. (Nuclear Explosions in the Atmosphere, on the Ground, and Underground: Electromagnetic Pulse of Nuclear Explosions). Davydov, S. L. (ed.). Moscow; Voennoe Izdatel'stvo Ministerstva Oborony (1974). 235p.

A collection of 15 articles from foreign publications on the examination of the electromagnetic fields appearing near the center of nuclear explosions (electromagnetic pulse) is compiled. The articles discuss the nature of the electromagnetic pulse and give its basic parameters. Its damaging effects and means of protection are examined. (tr-auth)

21040 SITU LEACHING SOLVENT EXTRACTION-PROCESS. Lewis, A. E. (to United States Atomic Energy Commission). US Patent 3,823,981. 16 Jul 1974. Filed date 4 Apr 1973. 8p.

A nuclear explosive is detonated in an ore deposit below the water table to provide fragmented ore disposed in a nuclear chimney which serves as an in situ pressure vessel. The vessel is filled with water from external sources or by flow from the formation and oxidizing gas is bubbled through the ore to oxidize and dissolve metal values therein. An organic extractant solution is then contacted with the aqueous phase in the vessel and is circulated to the surface where the metal values are recovered therefrom. Following makeup the organic phase is recycled into the nuclear chimney. (Official Gazette)

Protective Structures and Equipment

Refer also to abstracts 21092 and 21186.

21041 (AED-CONF-73-546-009) RADIATION PROTECTION DEVICES AND THEIR APPLICATION. Baeuml, A.; Widenmann, L. (Bundesgesundheitsamt, Neuherberg/Muenchen (F. R. Germany). Abt. fuer Strahlenhygiene). 1973. 13p. (In German). INIS.

From 14th annual meeting of the Vereinigung Deutscher Strahlenschutzaerzte; Wuerzburg, Germany (16 Nov 1973).

Technical means to reduce the radiation dose such as shielding devices (lead rubber plates, protective aprons, devices for the protection of the ovaries and testes, protective walls and platforms), with various apparatuses for reducing and controlling the radiation exposure (e.g., protective tube housing, tubes, filter, diaphragms, fluoroscope timers, dosimeters, and holding devices), and with detector systems which can be used to reduce the required dose (such as intensifying screens, combined with highly sensitive film material, optimum film treatment, image-intensifier-fluoroscopy by television including image recording and storage on magnetic tape) are discussed. According to paragraph 12 of the x-ray Ordinance, the radiation dose to the patient has to be kept as low as possible, and it is generally accepted that the lower the dose to the patient, the lower the emission of parasitic x-rays which may affect the medical personnel. The most effective measure to reduce the integral dose is the proper dimensioning of the field size, particularly in the case of fluoroscopic examinations. Full-size x-rays should be replaced by radiograms taken with the aid of image intensifiers and television cameras, which can lead to a reduction of $1/_{20}$ to $1/_{100}$. The required minimum radiation protection equipment depends on the type of the x ray devices and on the scope of operation so that there is no standard equipment to be recommended or required. (INIS)

21042 (AED-CONF-74-157-013) DEVELOPMENT OF A MONITORING FILTER FOR IODINE. Garder, K.; Vagalid, T. (Institutt for Atomenergi, Kjeller (Norway)). 1974. 5p. INIS.

From seminar on the monitoring of radioactive effluents; Karlsruhe, Ger. (14 May 1974).

The development of a monitoring filter for iodine involved tests with various types of charcoal and the design and testing of a suitable filter cartridge. The charcoal filters were tested under conditions similar to those under which they would be used. An attempt was made to obtain an absolute measurement of the filter efficiency by comparing the accumulated ^{131}I activity on the charcoal filters with measurements of ^{131}I in air samples with vacuum jars. This method allowed determination of the filter efficiency under the varying operating conditions normally encountered in practice at nuclear plants. A description of the filter is given. More than three years experience with the filter for monitoring gaseous effluents is discussed. (GE)

21043 (LA-5612-PR) RESPIRATOR STUDIES RELATED TO THE AEC DIRECTORATE OF REGULATORY STANDARDS, JANUARY 1–DECEMBER 31, 1973. Held, B. J.; Lowry, P.; Bevis, D. A.; Davis, T. O. Jr.; Geoffrion, L. A.; Hack, A. L.; Moore, T. O.; Pritchard, J. A.; Richards, C. P. (Los Alamos Scientific Lab., N. Mex. (USA)). May 1974. Contract W-7405-eng-36. 16p. Dep. NTIS $4.00.

During calendar year 1973, the LASL Respirator Research and Development Section, Industrial Hygiene Group, performed laboratory studies and consulting services for the AEC Directorate of Regulatory Standards (DRS). Major efforts included writing a draft of a manual for respiratory protection against airborne radioactive materials, organizing and hosting a respirator symposium (sponsored jointly by DRS, LASL, and the AEC's Division of Operational Safety), providing respirator training for AEC Regional Office personnel, testing special respiratory protective devices, working on development of a rapid method for fitting individuals with respirators on the basis of facial dimensions, and providing consulting services for the DRS. (auth)

Vacuum Engineering

Refer also to abstract 21899.

ENVIRONMENTAL AND EARTH SCIENCES

21044 (UCRL-51588) INTERAGENCY CONFERENCE ON THE ENVIRONMENT: A POST-CONFERENCE SURVEY. Sauter, G. D.; Miller, C. F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 11 Jun 1974. Contract W-7405-eng-48. 16p. Dep. NTIS $4.00.

The Interagency Conference on the Environment, held at LLL in October 1972, brought together nearly 200 representatives of the U. S. Environmental Protection Agency (EPA), the Atomic Energy Commission (AEC), the National Aeronautics and Space Administration (NASA), and the various AEC and NASA laboratories. It was held to promote an effective exchange of ideas and information on environmental research and to explore ways in which the capabilities and facilities of these laboratories might be more effectively used to complement and supplement existing EPA environmental research programs. Some months after the conference, many of the participants were interviewed to determine the effectiveness and the impact of the conference. They were asked their opinions regarding the desirability and potential for establishing cooperative multi-agency environmental research programs and the barriers to such cooperation that remain to be overcome. This survey indicated that, although only a few specific research projects resulted from it, the conference was considered very successful as a medium of information exchange. Further, given some of the perceptions of "other agency" attitudes, the current level of interagency cooperation and coordination is not likely to increase. Some guidelines for enhancing cooperation are suggested. (auth)

Minerals and Ores

Refer also to abstracts 20730, 21421, and 23289.

21045 (BVLI-27) RADON MEASUREMENTS IN NORWEGIAN MINES. Myran, T. (Bergverkenes Landssammenslutnings Industrigruppe, Trondheim (Norway)). Apr 1973. 91p. (In Norwegian). Dep. NTIS (US Sales Only) $8.00.

Following reports in 1970 of disturbingly high radon concentrations in some Swedish mines measurements were begun in Norwegian mines in 1971. Following a general introduction to the problem of radon in mines and geological factors affecting its occurrence, the biological effects and health hazards are discussed. Ventilation is treated at some length. The Swedish results are summarised and lung cancer studies in USA, Canada, and Great Britain are referred to. The measurement of radon and its daughters is discussed and the methods used in the present case presented. The results for the Norwegian mines are then discussed and related to the geological conditions. The radon concentrations in the Norwegian mines are very much lower than those in the Swedish mines. This is very difficult to explain and does not seem to be due to geological differences. The radon levels in the Norwegian mines give no cause for concern and probably other factors, dust, diesel exhaust and blasting fumes constitute a greater potential risk to health. (NO)

21046 (UCLA-34-P-134-10) BIOLOGICAL CYCLING OF ELEMENTS AND STABLE ISOTOPES IN MARINE ENVIRONMENTS. Progress Report, May 1, 1973–May 1, 1974. Kaplan, I. R. (California Univ., Los Angeles (USA)). 1974. Contract AT(04-3)-34. 18p. Dep. NTIS $4.00.

Data are reported on the content of uranium in drill core samples obtained at different depths from various locations in the Pacific Ocean off the California coast. Data are included on ratio of ^{234}U to ^{238}U in the samples. Humic acids in the sediments tended to act as reservoirs for U, and as the quantity of humic acid increased more U was separated from other minerals and exchange with sea water occurred. Data are also included on the content of organic carbon in the drill core samples. (CH)

21047 MINERAL RESOURCES OF AUSTRALIA. Noakes, L. C. (Bureau of Mineral Resources, Canberra, Australia). Search; 5; No. 1-2, 11-16(1974).

Australia's mineral inventory, although incompletely known, serves industry very effectively with one major long-term deficiency in crude oil. Current exports are based on extensive domestic resources, particularly of iron ore, coal and bauxite which together form the basis for 65% of the value of mineral exports. Australia's long-term mineral development cannot be assessed only in terms of reserves in sight; the ore of the future lies not so much in current reserves as in other categories of resources—marginal, submarginal and latent, and yet-to-be-discovered—whose appreciation calls for a degree of technical knowledge and judgement. Australia's mineral development is firmly based; but continued effective development will demand rising levels of funds and technical expertise in both exploration and resource management. (auth)

21048 FINANCING REQUIREMENTS FOR FUTURE URANIUM EXPLORATION AND PRODUCTION IN CANADA. Gregg, L. T. pp Addendum to Vol. 3 of Proceedings of the thirteenth Annual International Conference of the Canadian Nuclear Association. Toronto; Canadian Nuclear Association (1973).

From 13th annual international conference of the Canadian Nuclear Association; Toronto, Ontario (17 Jun 1973).

Current Canadian uranium reserves are compared with future worldwide demands for the remainder of the century. The amount of new exploration and production for Canada to maintain her present market position of 20% of Western World production is estimated. The capital required to support this increased effort in exploration and development through 1990 is also estimated. (CA)

21049 CHANGING ROLE FOR NUCLEAR FUELS. Runnalls, O. J. C. (Dept. of Energy, Mines and Resources, Ottawa). Paper No. CNA'73-604 of Proceedings of the Thirteenth Annual International Conference of the Canadian Nuclear Association. Toronto; Canadian Nuclear Association (1973).

From 13th annual international conference of the Canadian Nuclear Association; Toronto, Ontario (17 Jun 1973).

Canada's past and present roles in the international uranium industry are reviewed. Latest estimates of Canadian resources are given and discussed in terms of future trends on the world market. (CA)

21050 EXPLORATION FOR URANIUM ORES. Part I. Saum, N. M.; Link, J. M. (Colorado School of Mines Research Inst., Golden). Colo. Sch. Mines, Miner. Ind. Bull.; 12: No. 4, 1-23(Jul 1969).

Following introductory data on the discovery of uranium in 1789 and on future uranium demands for US nuclear power plants, detailed information is presented on: the nuclear and geochemical properties of U; the formation and types of U deposits; exploration methods including geologic, geophysical, geochemical, and remote sensing methods; drilling programs; and the planning of an exploration program. A 172-item bibliography is included. (LCL)

21051 MINING YEAR BOOK, 1974. Papers Presented at the National Western Mining Conference and Exhibition, Denver, Colorado, February 7–9, 1974. Denver; Colorado Mining Association (1974). 134p. (CONF-740208-). $7.50.

Forty-four papers were presented. A separate abstract was prepared for each of 4 papers. The remaining 40 papers were not within the scope of NSA. (LCL)

For abstracts of individual papers see: 21052–21055.

21052 EXPLORATION ECONOMICS AS APPLIED TO URANIUM. Steele, R. M. (Homestake Mining Co., San Francisco); Pederson, J. A. pp 49-53 of Mining Year Book, 1974. Denver; Colorado Mining Association (1974).

From national western mining conference; Denver, Colorado, USA (9 Feb 1974). See CONF-740208-.

An analysis is presented of the economics of exploration effort in terms of cost and results as applied to the search for uranium in the United States. Three different phases: the historical costs of search and production, the nature of known occurrences, along with planning and budgeting considerations are presented. Two aspects of exploration costs, land acquisition and exploration effort are investigated to show the impact that changes in these parameters have on project profitability by the use of an economic model based on AEC data. The fuel resource base of the nuclear industry was studied and compared to some alternate fuels. (auth)

21053 STATUS OF URANIUM EXPLORATION. Gabelman, J. W. (Atomic Energy Commission, Washington, DC). pp 72-81 of Mining Year Book, 1974. Denver; Colorado Mining Association (1974).

From national western mining conference; Denver, Colorado, USA (9 Feb 1974). See CONF-740208-.

The development of uranium exploration technology can be correlated directly with the independent variables of known supply, discovery incentive, and ease of discovery. In the history of uranium exploration, beginning with radium in 1910, interpretive uranium geology has been directly responsible for very few discoveries, but progressed rapidly during the two short periods of booming demand. During intervening periods technology coasted but became useful in mining operations as long as known ore supply persisted. However, when new demands suddenly exceeded

supply by large factors, geological technology again could not be immediately effective. Fortunately in each case new deposits were discoverable by statistical or engineering technology. Historically new kinds and sizes of deposits were discovered both times by untrained prospectors, and developed by risk capital stimulated by suitable incentives. Similar histories were experienced by other metals. Thus, geology has followed exploration and evolved by incorporating new data from discoveries. The improved technology is useful for discovering or developing the remaining similar deposits in recognized districts, but has not efficiently identified new districts. Exploration could succeed independently as long as new deposits were easily discoverable. However, when deposits are no longer easily discoverable, exploration naturally tries to follow geology. The exploration industry faces the third and largest demand in its history. Renewed exploration under geological guidance has proceeded for several years at the highest investment and performance rate ever; yet the results are disappointing. Discoveries have only offset production, and have been restricted to margins of known districts. No new districts have been found. One cause is believed to be exhaustion of possibilities recommended by existing concepts of uranium geology and the lack of new effective concepts. Revised or new concepts might permit geology to lead exploration more fruitfully at this critical time when it is first being seriously relied upon. (auth)

21054 URANIUM PROCUREMENT FROM A UTILITY VIEWPOINT. Rodgers, E. C. (Southern California Edison Co., Rosemead). pp 82-88 of Mining Year Book, 1974. Denver; Colorado Mining Association (1974).

From national western mining conference; Denver, Colorado, USA (9 Feb 1974). See CONF-740208-.

Uranium procurement is discussed from the viewpoint of a large electric utility heavily committed to nuclear power, namely the Southern California Edison Co. which will require about 36 million pounds of ^{308}U between 1977 and 1990 to supply the 13 nuclear power plants it plans to have in service by 1990. The following questions are answered: how much U will be needed and when; where can it be found; and what price should it be. It is concluded that both producers and buyers must work together to keep U prices reasonable and fair and thereby preserve the health of the nuclear power industry. (LCL)

21055 URANIUM INDUSTRY IN WESTERN EUROPE. Siegers, A. (Urangesellschaft mbH and Co., Denver). pp 89-91 of Mining Year Book, 1974. Denver; Colorado Mining Association (1974).

From national western mining conference; Denver, Colorado, USA (9 Feb 1974). See CONF-740208-.

Presently, with the exception of France, virtually all uranium used in Western Europe is imported from oversea sources. European governments and industry are closely working together to secure the future supply for uranium, since it is likely that the present energy shortage will push forward construction of nuclear reactors. Uranium for Western Europe will have to continue to come from outside sources. The political situation in most prospective countries of the world will impose the necessity of dealing directly with governments, including partnerships with them. For various reasons, it is unlikely that we will be able to import uranium from eastern countries. (auth)

21056 PETROGRAPHY OF LOWER TAL PHOSPHORITES, MUSSOORIE, SYNFORM, UTTAR PRADESH, INDIA. Pareek, H. S. (Geological Survey of India, Lucknow). Proc. Indian Nat. Sci. Acad., Part A; 38: No. 3-4, 62-88(1972).

Phosphorites occur as thin to thick bands in the Lower Tal formations of the Mussoorie synform in Dehradun and Tehri districts of Uttar Pradesh, India. The phosphorites appear as bedded-massive, bedded, platy, lenticular, nodular, pelletal or granular, fragmentary, and oolitic varieties, that are named so, on the basis of the predominant mode of occurrence of the phosphates. The phosphate mineral is commonly opaque, as masked by carbonaceous matter, but the outcrop specimens reveal their inherent nature. Many of the phosphate bodies have oxidized rims of anisotropic nature. These varieties are described and illustrated. The matrix is siliceous, calcareous, or clayey, being weakly to moderately phosphatic. Of all the phosphorites examined, the ultra-fine-grained matrix shows maximum radioactivity. Pyrite is in intimate association with the phosphates as a replacing mineral, and isolation of the pure phosphate from such associations is difficult, unless pyrite can be transformed into pyrrhotite by thermal heat, and separated magnetically. (auth)

Radioactive Effluents

Refer also to abstracts 20817 and 20838.

21057 (AED-CONF-74-157-011) THE MONITORING OF RADIOACTIVE GASEOUS EFFLUENT DISCHARGED FROM NUCLEAR INSTALLATIONS IN THE UNITED KINGDOM. Carr, J. A.; Scott, G. (Ministry of Agriculture, Fisheries and Food, London (UK). Food Science and Health Div.). 1974. 5p. INIS.

From seminar on the monitoring of radioactive effluents; Karlsruhe, Ger. (14 May 1974).

The principles governing the control of emissions of radioactive gases to atmosphere from nuclear sites in the United Kingdom are discussed. Specific limits for the radionuclides discharged are not usually detailed by the authorizing departments who generally prefer to rely on the "best practicable means" approach to minimize emissions. (auth)

21058 (AED-CONF-74-157-012) CONTINUOUS MONITORING OF RADIOACTIVE LIQUID EFFLUENTS. Peray, R.; Juste, G.; Descamps, A. 1974. 13p. (In French). INIS.

From seminar on the monitoring of radioactive effluents; Karlsruhe, Ger. (14 May 1974).

A device for the radioactive control of suspicious liquid wastes from the Laboratoire d'Examens des Combustibles Actifs of the Cadarache Centre d'Etudes Nucleaires is described. This installation allows continuous radioactivity detection of the suspect wastes. It has an automatic system for the extraction of wastes in vats in case a threshold is passed or for safety reasons. (tr-auth)

21059 (AEC-CONF-74-157-014) THE MONITORING OF RADIOACTIVE LIQUID EFFLUENT DISCHARGED INTO THE ENVIRONMENT FROM NUCLEAR INSTALLATIONS IN THE UNITED KINGDOM. Stott, G.; Hetherington, J. A. (Ministry of Agriculture, Fisheries and Food, Lowestoft (UK). Fisheries Radiobiological Lab.). 1974. 13p. INIS.

From seminar on the monitoring of radioactive effluents; Karlsruhe, Ger. (14 May 1974).

In the United Kingdom the disposal of radioactive liquid waste into the environment from nuclear sites is formally authorized. The monitoring of such effluent streams prior to discharge is necessary for a number of reasons. This paper describes the philosophy of the United Kingdom authorizing departments in requiring pre-discharge monitoring of liquid effluents by nuclear site operators. Sources of wastes and isotopic analyses of some effluents are discussed. (auth)

21060 (EPA-520/6-74-002) EVACUATION RISKS: AN EVALUATION. Hans, J. M. Jr.; Sell, T. C. (National Environmental Research Center, Las Vegas, Nev. (USA)). Jun 1974. 161p.

In the event of an incident at a fixed nuclear facility which can cause or potentially cause radiation exposure to the public in the vicinity of the facility, appropriate protective measures must be identified which will substantially reduce or avert the exposures. One of these protective measures is to evacuate the public from the affected area. Evacuation, like radiation exposure, can impose risks upon the affected population group. These risks should not exceed the risks from radiation exposure that would otherwise occur if no evacuation took place. Although the risks from radiation exposure can be estimated to some degree, no evacuation risk studies have been available to provide a basis for decisions concerning the application of this protective action. Based on the study of individual evacuations and consultation with persons having experience in managing and studying various aspects of evacuations, it was concluded that: advanced planning is essential to identify potential problems that may occur in an evacuation; the risk of injury or death to evacuees does not change as a function of the numbers of persons evacuated; the risk of injury or death to evacuees can be approximated by the National Highway Safety Council statistics for motor vehicle accidents, although subjective information suggests that the risks will be lower; most of the evacuees utilize their own personal transportation during an evacuation; most of the evacuees assume the responsibility of acquiring food and shelter for themselves; evacuation costs are highly area-dependent and should be computed based on local demographic, economic, and geographic conditions; no panic or hysteria has been observed in evacuations; and that large or small population groups can be effectively evacuated from impact areas with minimal death and injury risks and, in most cases, they can take care of themselves provided adequate plans are developed and executed to minimize potential problems that may occur peculiar to the impact area. Costs would probably not be a deterrent in initiating an evacuation. (280 references) (CH)

21061 ENERGY POLICY AND ENVIRONMENTAL PROTECTION. Hauff, V. (Bundesministerium fuer Forschung und Technologie, Bonn (F.R. Germany)). Atom-Inform.; No. 3, 3-7(1974). (In German).

On the occasion of a public hearing of the district council of Emmendingen on the 15th of February this year, the parlimentary

secretary of state in the Federal Ministry for Research and Technology, Dr. Volker Hauff, answered questions relating to the federal energy policy and to problems of environmental protection. During this meeting, the district council was informed about the planned construction of a nuclear power plant in Wyhl (Baden). The reasons for economic energy generation are explained and environmental problems such as the emission of air-polluting substances from nuclear power plants, and possible reactor malfunctions are discussed. (GE)

21062 CALCULATIONS OF DOSE, POPULATION DOSE, AND HEALTH EFFECTS DUE TO BOILING WATER NUCLEAR POWER REACTOR RADIONUCLIDE EMISSIONS IN THE UNITED STATES DURING 1971. Martin, J. A. Jr.; Nelson, C. B. (Environmental Protection Agency, Washington, DC). Radiat. Data Rep.; 15: No. 6, 309-319(Jun 1974).

From symposium on the physical behavior of radionuclides released to the atmosphere; Vienna, Austria.

Atmospheric emissions of radionuclides during 1971 reported by operators of 10 boiling water nuclear power reactors in the United States were analyzed to calculate resulting doses in the general offsite environment. A recently developed computer program (AIREM) was used to perform the calculations. A sector-averaged diffusion equation, using facility generated onsite annual average meteorology, was used to propagate the emissions from the release point out to 80 kilometers. In 1971, 3.2 million Ci of radioactivity were released to the atmosphere from 10 reactors. The resulting whole body population dose was calculated to be 900 person-rem. The health effects associated with this population dose were calculated to be small fractions of those induced by natural background radiation. (auth)

Radioactivity Monitoring and Transport

Refer also to abstracts 20641, 20688, 21172, 21368, 21369, 21421, 21893, 21894, 23073, and 23153.

21063 (AEC-tr-7570) USSR REPORTS ON NATURAL AND FALLOUT RADIOACTIVITY. (USAEC Health and Safety Lab., New York). Jul 1974. Translation of Russian Articles. 179p. Dep. NTIS $12.00.

A separate abstract was prepared for one of the 13 papers included. Abstracts of the 12 additional papers appeared in NSA previously as numbers 27: 27594, 30: 06530, 06533, 06540, 06541, 09555, 09989, 12688, 12699, 12700, 15399, and 16016. (CH)

For an abstract of an individual paper see: 21124.

21064 (CH-1459) REPORT FOR MONTH ENDING FEBRUARY 29, 1944. (Chicago Univ., Ill. (USA)). 3 Apr 1944. 64p. Dep. NTIS $6.25.

Results are reported from radiation monitoring of the environment and personnel during 1944. Personnel monitoring activities included the examination of finger impressions of personnel for signs of radioinduced changes. A number of standard biochemical and hematological tests were evaluated in laboratory animals as to their usefulness as indications of radioinduced changes in personnel. Preliminary results are reported from studies on mice, rats, rabbits, guinea pigs, and gold fish of the biological effects of exposure to external irradiation (β, γ, fast neutron, or x) or to internal irradiation following the administration of ^{89}Sr, ^{90}Y, ^{140}Ce, ^{140}Ba, ^{140}La, or ^{95}Cb. The toxic effects of Pu and U were also studied in animals, but no results are reported. (CH)

21065 (CN-2238) MONTHLY HEALTH REPORT ON PROBLEMS RELATING TO PRODUCT FOR PERIOD ENDING SEPTEMBER 31, 1944. (Chicago Univ., Ill. (USA)). 13 Oct 1944. 7p. Dep. NTIS $4.00.

Results of radiation monitoring of the environment and personnel of a Pu laboratory during 1944 are reported. A method of sample preparation for the radiometric determination of Pu in urine is described. Data are included from studies on the tissue distribution and retention of Pu in rats following inhalation of $PuCl_4$ aerosols or PuO_2 smoke or the injection of Pu solutions. The effectiveness of lanthanum fluoride for the removal of Pu from tissue ashes was tested. (CH)

21066 (CN-2786) HEALTH PROBLEMS RELATING TO PRODUCT FOR MONTH OF MARCH 1945. Jacobson, L. O. (Chicago Univ., Ill. (USA)). 12 Apr 1945. Contract W-7401-eng-37. 35p. Dep. NTIS $4.75.

Results of radiation monitoring activities for the environment and personnel of a Pu laboratory in 1945 are reported. Methods for sample preparation of urine and feces for the radiometric determination of Pu are described. Data are included from studies on mice, rats, and dogs of the tissue distribution, excretion, retention, and toxic effects of Pu following inhalation, intratracheal administration, or intravenous, intramuscular, or subcutaneous injection. Blood chemistry studies showed the binding of Pu by blood proteins. (CH)

21067 (CN-2905) MONTHLY HEALTH REPORT ON PROBLEMS RELATING TO PRODUCT FOR MONTH OF APRIL 1945. (Chicago Univ., Ill. (USA)). 9 May 1945. Contract W-7401-eng-37. 29p. Dep. NTIS $4.50.

Results of radiation monitoring activities for the environment and personnel of a Pu laboratory in 1945 are reported. Methods for sample preparation of urine and feces for the radiometric determination of Pu are described. Data are included from studies on mice, rats, and dogs of the tissue distribution, excretion, retention, and toxic effects of Pu following inhalation of PuO_2 smoke or injection as $PuO_2(NO_3)_2$. Autoradiographic studies of bone tissues showed the microscopic sites of Pu deposition in bone. A method of sample preparation of large samples of soft tissues for radiometric analysis is described. The toxic effects of injected Pu and Ra were compared in rats. (CH)

21068 (CN-2992) MONTHLY HEALTH REPORT ON PROBLEMS RELATING TO PRODUCT FOR MONTH OF MAY 1945. Barron, E. S G. (Chicago Univ., Ill. (USA)). 15 Jun 1945. Contract W-7401-eng-37. 48p. Dep. NTIS $5.50.

Results are reported from monitoring of the environment and personnel of a Pu laboratory for α activity in 1945. Methods for the preparation of samples of urine and feces for radiometric determination of Pu are described. Data are included from studies on the toxic effects of injected or inhaled Pu in mice and rats and a comparison of the toxic effects of Pu and Ra. (CH)

21069 (CN-3167) REPORT OF CONFERENCE ON PLUTONIUM, MAY 14TH AND 15TH. Nickson, J. J. (ed.). (Chicago Univ., Ill. (USA)). 23 Jul 1945. Contract W-7405-eng-39. 62p. Dep. NTIS $6.25.

Data available in 1945 relevant to the development of radiation protection standards for personnel working with Pu are summarized. Results are reviewed from studies in mice, rats, and dogs on the tissue distribution, retention, excretion, and toxicity of Pu at various times following intake by various routes, and the effects of the administration of metals and other chemical treatments for increasing the excretion rate. Data on the amounts of Pu excreted in the urine and feces of personnel are discussed. Areas needing investigation listed include: the evaluation of excretion data as an indication of body burden; the development of a method for the detection and quantization of Pu in wounds; an evaluation of hazards resulting from the skin absorption of various Pu compounds; and the development of monitoring methods for Pu in air. (CH)

21070 (KFK-1899, pp 183-190) COMPARISON OF THE RESULTS OF THE SPACE-AIR MONITORING AND THE INCORPORATION MONITORING AT THE KARLSRUHE NUCLEAR RESEARCH CENTER. Koenig, L. A.; Piesch, E.; Schieferdecker, H. (Gesellschaft fuer Kernforschung mbH, Karlsruhe, Ger.). Mar 1974. (In German).

The results of air monitoring and incorporation monitoring for the year 1972 are compared. This shows that the results of space-air monitoring can hardly be used to infer the degree of expected incorporation. Basic to this, besides the effects of the respirator protection measures, are the random nuclide-dependent detection limits of the various monitors as well as nonrepresentative samples from air probe samplers. It is worth mentioning that incorporated particles played a very small role in the radiation burden of monitored workers. (tr-auth)

21071 (KFK-EXT-23/74-1) RESULTS OF MONITORING FOR TRITIUM INCORPORATION AT THE KARLSRUHE NUCLEAR RESEARCH CENTER IN 1973. Schieferdecker, H.; Wechselberger, E. (Kernforschungszentrum Karlsruhe (F. R. Germany). Medizinische Abt.). Apr 1974. 10p. (In German). Dep. NTIS (US Sales Only) $4.00.

In 1973 461 personnel at the Karlsruhe Nuclear Research Center were monitored for tritium incorporation. It appeared that unduly high incorporations did not occur. The maximum radiation burden due to tritium incorporated ranged from 50 to 200 mrem/yr for persons working at the two heavy-water moderated reactors and was, thus, lower than in the year before. (auth)

21072 (LA-5586) ENVIRONMENTAL SURVEILLANCE AT LOS ALAMOS DURING 1973. Schlager, K. J.; Apt, K. E. (Comps.). (Los Alamos Scientific Lab., N. Mex. (USA)). May 1974. Contract W-7405-eng-36. 63p. Dep. NTIS $5.45.

The CY 73 environmental monitoring program of the Los Alamos Scientific Laboratory (LASL) is described. Data are presented for concentrations of radioactivity measured in air, ground and surface waters, liquid effluents, sediments, and soils and are com-

pared with those of AEC guides and/or data from other reporting periods. Levels of external penetrating radiation measured in LASL environs are given. The average whole body radiation dose to residents of Los Alamos County resulting from LASL operations was calculated. Chemical and biological qualities of liquid effluents and surface and ground waters of LASL environs were determined, and are compared to applicable standards. Results of related environmental studies are presented. Ecological investigations include (a) an environmental inventory of LASL and environs, (b) the honeybee as a potential tritium indicator organism, (c) radionuclides in Los Alamos area canyon ecosystems, and (d) physical and chemical characterization of Los Alamos area soils. Results are given of meteorological investigations of Los Alamos climatological records, rainfall distributions, and windfield patterns. There are also data pertaining to the geo-hydrological determination of flood frequencies and maximum discharges of Los Alamos area canyons. Environmental control activities are described which should be of benefit to LASL planning. (auth)

21073 (LFEN-158(B)) ENVIRONMENTAL RADIOACTIVITY MEASUREMENTS AT THE LABORATORIO DE FISICA E ENGENHARIA NUCLEARES (1966–1970). Godinho, M. M.; Teixeira, R.; Teixeira, M. R.; Bordalo, M. M.; Costa, P. E.; Faisca, M. C.; De Brito, Q. (Junta de Energia Nuclear, Sacavem (Portugal). Lab. de Fisica e Engenharia Nucleares). 1973. 44p. Dep. NTIS (US Sales Only) $5.25.

At the Laboratório de Física e Engenharia Nucleares gross beta activity measurements and radionuclides determinations such as ^{137}Cs, ^{90}Sr and ^{131}I were carried out in several environmental samples, from 1966 to 1970. Some of these samples were measured by gamma spectrometry. The results obtained are presented and the evolution of gross beta activity since 1961 to 1970 is shown. (auth)

21074 (N-2200) MEDICAL INDUSTRIAL HAZARDS SECTION REPORT FOR MONTH OF JANUARY 1946. Nickson, J. J. (Chicago Univ., Ill. (USA)). 19 Jan 1946. 7p. Dep. NTIS $4.00.

Results are summarized from radiation monitoring of the environment and personnel during January 1946. Urine samples of personnel were analyzed as an indication of body content of Pu. The hands of personnel and protective clothing were also monitored for β-γ activity. Film badge and pocket meter readings during the period are also reported. Results are reported from the radiometric analysis of 24-hr urine samples collected during 15 days following the injection of 94.91 μg of Pu into two human volunteers. (CH)

21075 (N-2224) MEDICAL INDUSTRIAL HAZARDS SECTION REPORT FOR MONTH OF FEBRUARY 1946. Nickson, J. J. (Chicago Univ., Ill. (USA)). 21 Feb 1946. 5p. Dep. NTIS $4.00.

Results are summarized from radiation monitoring of the environment and personnel during February 1946. Urine samples of personnel were analyzed as an indication of body content of Pu. No specimen indicated retention above 0.4 mg and less than 2% of the specimens showed retention above 0.1 μg. (CH)

21076 (N-2261) MEDICAL INDUSTRIAL HAZARDS SECTION REPORT FOR MONTHS MARCH AND APRIL 1946. Nickson, J. J. (Chicago Univ., Ill. (USA)). 22 Apr 1946. 6p. Dep. NTIS $4.00.

Personnel monitoring activities at a Pu laboratory during 1946 are reported. Data are included on the α radioactivity on air filters, readings of personnel dosimeters (which showed 0.3% of the total number of readings greater than 100 mr), and Pu excretion in urine and sputum of personnel as determined by radiometric analysis of samples. A contamination incident is described that resulted from the explosion of approximately 1 to 2 grams of Pu in an alkaline silver solution. Results are reported from studies in dogs of the effects of injected solutions of BAL or Zr on increasing Pu excretion. (CH)

21077 (ORNL-4974) APPLIED HEALTH PHYSICS AND SAFETY ANNUAL REPORT FOR 1973. (Oak Ridge National Lab., Tenn. (USA)). Aug 1974. Contract W-7405-eng-26. 56p. Dep. NTIS $5.45.

Data from environmental and personnel radiation monitoring program at ORNL during 1972 are summarized. There were no external or internal exposures to personnel which exceeded the standards for radiation protection and no releases of gaseous or liquid wastes that were of a level that required an incident report to the AEC. The quantity of radionuclides of primary concern in the Clinch River averaged less than 0.5% of the MPC values. (CH)

21078 (PEL-229) ENVIRONMENTAL RADIOACTIVITY AT THE NATIONAL NUCLEAR RESEARCH CENTRE, PELINDABA. Report for the Year 1972. van As, D.; Vieggaar, C. M. (Atomic Energy Board, Pelindaba, Pretoria (South Africa)). Nov 1973. 20p. Dep. NTIS (US Sales Only) $4.00.

A revised environmental survey programme, introduced during 1970 with the emphasis on monitoring of the critical paths of exposure of the general public, was continued in 1972. Results of determinations of both gross radioactivity and individual nuclides in samples of fish and water (which are critical materials for liquid effluent releases) from the Hartbeespoort Dam and from the Crocodile River, are given and discussed. Results of gamma-spectrometric, ^{131}I and ^{90}Sr analyses of milk, the critical material for releases to the atmosphere, are presented. Results are given of regular investigations of the composition of effluent releases. These investigations are performed in order to be able to detect other possible critical nuclides. Levels of deposited and airborne activity from nuclear bomb tests are reported. (auth)

21079 (RFP-2164) CESIUM-137 FALLOUT IN RED DESERT BASIN OF WYOMING, USA. Michels, D. E. (Dow Chemical Co., Denver, Colo. (USA). Rocky Flats Div.). 15 Jul 1974. Contract AT(29-1)-1106. 8p. Dep. NTIS $4.00.

High variability characterizes fallout cesium-137 in the Red Desert Basin of Wyoming in the U. S. Correlations between fallout levels and factors of climate, topography, and vegetation suggest that bare soil more readily captures fallout from wind than does sagebrush; that wet fallout processes are of little significance in this arid place; that association between cesium-137 and snow is weak, hence drifting of snow is not a significant factor in the distribution of fallout; and that impingement of fallout particles directly on soils by wind action may be the dominant mechanism of fallout deposition in the Basin. Analysis was not conclusive when the data were sorted according to a single parameter; either mean annual precipitation or topography or vegetation. However, significant differences between average values and smaller values for standard deviations result when sorting is done according to two parameters, topography and vegetation. Highest levels of cesium-137 were found on barren ridges which, in the Basin, are exposed to persistent synoptic winds. (auth)

21080 (RFP-Trans-162) DISTRIBUTION AND REDISTRIBUTION OF URANIUM, RADIUM, AND THORIUM IN NATURAL BIOGEOCENOSES. Verkhovskaya, I. N.; Vavilov, P. P.; Maslov, V. I. [nd]. Translated from pp 243-256 of Radioekologicheskie Issledovaniya v Prirodnykh Biogeotsenozakh, Izdatel'stvo Nauk, Moscow, 1972. 11p. Dep. NTIS $4.00.

The distribution and redistribution of naturally radioactive elements in soils, water, plants, and animals was investigated. On the basis of the wide range of questions studied on the amount, distribution, and migration of naturally radioactive substances in soils and in floral and faunal organisms in various zones of the northern taiga in regions with elevated radiation levels it was established that the distribution of uranium, radium, and thorium through horizons of the soil profile depends on the type of soils, the character of soil formation, and phytocenoses. As regards plants, trees, shrubs, grassy growths, and mosses along with the upward flow of water (together with other mineral substances) take up from the soil soluble forms of radium, uranium, and thorium into their overground parts. It is important to note that the relation of radioelements entering the plants does not correspond to their relation in the soil. In order of amount of uptake, they are radium, uranium, then thorium. An acropetal gradient of radioelement distribution is noted for all plants, as well as a higher content of these elements in older portions of plants. All the radioelements (including even radium, the most mobile of them) are practically incapable of being reutilized within plants. They remain deposited in the same spot at which they initially arrived along with the ascending water flow. The radioelement content of a large number of wild animals inhabiting radium, uranium–radium, and thorium sectors makes it possible to determine the movement of radioelements incorporated into the organism of animals through the food chain. The degree of participation of individual groups of animals in the removal of radioelements from the soil and their dispersal over the land surface was established. (LCL)

21081 ENVIRONMENTAL RADIATION MEASUREMENTS NEAR MADDALENA ISLAND. Com. Naz. Energ. Nucl., Notiz.; 20: No. 5, 87-90(May 1974). (In Italian).

A set of tables shows the data obtained through environmental radioactivity measurements carried out near Maddelena Island by CNEN's Environmental Radioactivity Laboratory from 1972 through 1974. (auth)

21082 RADIOEKOLOGIYA VODNYKH ORGANIZMOV. II. Raspredelenie i Migratsiya Radionuklidov v Presnovodnykh i Morskikh Biotsenozakh. (Radioecology of Water Organisms. II. Distribution and Migration of Radionuclides in Freshwater and Sea-Water Biocenoses). Andrumaitis, G. P. (ed.). Riga; Izdatel'stvo Zinatne (1973). 339p.

Separate abstracts were prepared for the 42 chapters of the book. (HLW)

For abstracts of individual chapters see: 21083, 21101, 21110–21120, 21129–21151, 21354, 21422, and 21430–21433.

21083 INVESTIGATIONS ON ADSORPTION OF ^{60}Co AND ^{137}Cs ON SURFACE OF BROWN ALGAE AND GLASS UNDER EXPERIMENTAL CONDITIONS. Buyanov, N. I. pp 298-304 of Radioekologiya Vodnykh Organizmov. II. Raspredelenie i Migratsiya Radionuklidov v Presnovodnykh i Morskikh Biotsenozakh. Andrumaitis, G. P. (ed.). Riga; Izdatel'stvo Zinatne (1973). (In Russian)

Data on the adsorption of ^{60}Co and ^{137}Cs on glass placed into the solution for the concentration of the mentioned radioisotopes by the brown algae are presented. The curves of radioactivity of glass plates and algae are similar. This testifies to the probably great role of adsorption on the algae surface in the concentration of radioisotopes. (auth)

21084 RADIOACTIVITY OF SOME PLANKTON AND SEA WATER SAMPLES COLLECTED DURING 1960–1968 PERIOD. Tassi Pelati, L. (Univ., Parma, Italy); Triulzi, C. Rapp. Comm. Int. Mer Mediter.; 20: No. 4, 735-737(1972).

Gross beta radioactivity measured in plankton samples is useful for an immediate visualization of the environmental radioactive contamination level; trends of plankton radioactivity from both North Adriatic and Ligurian-Tyrrhenian Seas collected during the 1960-1968 period are correlated with the same zone fallout. Gross beta radioactivity for such samples of plankton reached its highest values in 1963, following successively the trends of the fallout debris; in 1968 the same values recorded in 1961 were reached. (HLW)

21085 DATA. Section IV. Other Data. Radiat. Data Rep.; 15: No. 5, 281-307(May 1974).

Environmental monitoring near the Rocky Flats Plant during 1971 is described, and tabulated results are presented for: α monitoring of onsite and offsite air samples; Pu concentrations in air samples and in dust deposits; Pu, U, and Am concentrations in surface waters and effluent holding ponds; Pu in sediments and vegetation. Results are presented of β radioactivity monitoring of soils, vegetation and well water at the Sandia Laboratory site and at the Stanford Linear Accelerator Center site. Power reactors in the US as of March 31, 1974 are listed by site, name, capacity, owner, and expected operation date. (LCL)

21086 DATA. Section IV. Other Data. Radiat. Data Rep.; 15: No. 6, 356-374(Jun 1974).

Data obtained during 1971 are presented on: the radioisotopes content in Columbia River Water and in Richland, Washington drinking water; tritium content in Hanford plant environs ground water; gross α, gross β, and ^{131}I content in surface air in Hanford environs; ^{137}Cs, ^{90}Sr, ^{32}P, ^{65}Zn, and ^{131}I content in Hanford area milk; ^{32}P, ^{65}Zn, ^{90}Sr, ^{95}Zr, ^{106}Ru, ^{131}I, ^{137}Cs, and ^{144}Ce content in Hanford food products, ^{24}Na, ^{32}P, ^{65}Zn, and ^{137}Cs in muscle of game birds; and radioisotopes in Hanford soil and vegetation. Gamma exposure rates at the Columbia River shore line, dose estimates from the consumption of foods and drinking water, and a comparison of dose commitments from the ingestion of fallout-contaminated and plant waste-contaminated foods are presented for the years 1967 to 1972. The detection of nuclear detonations in India and the USSR during May 1974 is reported. (LCL)

Atmosphere

Refer also to abstracts 20838, 21045, 21057, 21062, and 21416.

21087 (CN-1892) STATUS OF PRODUCT MONITORING BY HEALTH PHYSICS SECTION. Parker, H. M. (Chicago Univ., Ill. (USA)). Sep 1944. 9p. Dep. NTIS $4.00.

The hazards of Pu uptake by personnel following inhalation, ingestion, or through wounds are discussed and preliminary estimates of maximum permissible intake levels are reported. Methods used in 1944 for monitoring Pu in air and on the skin of personnel are described. (CH)

21088 (KFK-1899) MEETING ON MONITORING ROOM AND EXHAUST AIR FOR RADIOACTIVITY, KARLSRUHE, NOVEMBER 15–16, 1973. Koenig, L. A. (ed.). (Kernforschungszentrum Karlsruhe (F. R. Germany). Abt. Strahlenschutz und Sicherheit). Mar 1974. 210p. Dep. NTIS (US Sales Only) $13.50.

Fifteen papers were presented. A separate abstract was prepared for each paper. (LCL)

For abstracts of individual papers see: 21070, 21089–21097, 21416, 21893, 21894, 23073, and 23153.

21089 (KFK-1899, pp 23-36) REQUIREMENTS IN THE MONITORING OF THE ESCAPE OF RADIOACTIVE MATERIAL IN THE EXHAUST GAS FROM NUCLEAR POWER PLANTS FROM THE VIEWPOINT OF THE RADIATION BURDEN AND EMERGENCY PRECAUTIONS. Schwibach, J.; Winkelmann, I. (Bundesgesundheitsamt, Neuherberg/Muenchen, Ger.). Mar 1974. (In German).

The requirements in the monitoring of the release of radioactive materials to the air from nuclear power plants are first considered from the viewpoint of the radiation burden that can be received from radioactive fission gases, aerosols containing short-lived radioisotopes such as ^{88}Rb, ^{89}Rb, and ^{138}Cs, radioiodine, aerosols containing long-lived Fe, Mn, or Co isotopes or ^{89}Sr and ^{90}Sr, and special radionuclides such as ^{3}H and actinides. The requirements in the case of an emergency are then summarized with emphasis on the emission from the chimney and precautions to be taken to eliminate them. Monitoring of emissions to the environment is discussed. (JSR)

21090 (KFK-1899, pp 39-46) MEASUREMENT OF RADIOACTIVE AEROSOLS. Gebauer, H. (Frieseke und Hoepfner GmbH, Erlangen-Bruck, Ger.). Mar 1974. (In German).

The problems of measuring radioactive aerosols separated by filters are presented. The technical arrangement of two step-filter systems are described and their lower detection limits are discussed. (tr-auth)

21091 (KFK-1899, pp 47-70) MONITORING RADIOACTIVE GASES, ESPECIALLY TRITIUM. Maushart, R. (Berthold/Frieseke Vertriebs-GmbH, Karlsruhe, Ger.). Mar 1974. (In German).

The status of techniques for monitoring gases and tritium is reviewed. All useful, frequently applied systems for continuous routine measurements are described, their advantages and disadvantages compared, and their calibration constants tabulated. (tr-auth)

21092 (KFK-1899, pp 71-84) IODINE MONITORING. Wilhelm, J. G. (Gesellschaft fuer Kernforschung mbH, Karlsruhe, Ger.). Mar 1974. (In German).

The sampling required for iodine monitoring in air or off-gas is described. Published data on a filter element suitable for the concentration of iodine for measurements are given. The principal specific parameters which affect the iodine separation and sampling are discussed and practical suggestions for their control are given. The most important aspects of the continuous measurement of I in air using an iodine monitor which can emit an alarm signal are described and results of the measurement of the smallest radioactive iodine concentrations in air using this I monitor are reproduced. (tr-auth)

21093 (KFK-1899, pp 85-98) PARTICLE SIZE DETERMINATION. Vaane, J. (Europaeisches Institut fuer Transurane, Karlsruhe, Ger.). Mar 1974. (In German).

The problem of determining particle sizes in α-radioactive aerosols is reviewed. After a short explanation of the problem, some of the applied concepts are defined. The most important techniques for particle size determination in α-radioactive material are then explained briefly. The reference literature for ongoing studies is given. Finally, the result of study conducted at the European Institute for Transuranium Elements on the particle size of some α-active radioisotopes is discussed. This shows that, in general, the particle size decreases with increasing specific activity, therefore the lung damage risk from inhaling this aerosol material becomes greater with increasing specific activity. (tr-auth)

21094 (KFK-1899, pp 99-103) ISO REGULATION "RECOMMENDATION FOR THE SAMPLING OF RADIOACTIVE MATERIALS CONTAINED IN THE AIR". Berger, H. U. (Kernforschungszentrum, Karlsruhe, Ger.). Mar 1974. (In German).

The contents of the ISO regulation are reviewed. (tr-auth)

21095 (KFK-1899, pp 147-151) SPACE AND EXHAUST GAS MONITORING IN REPROCESSING PLANTS OR OTHER LARGE TECHNICAL INSTALLATIONS. Finsterwalder, L. (Gesellschaft zur Wiederaufarbeitung von Kernbrennstoffen mbH, Karlsruhe, Ger.). Mar 1974. (In German).

The system used at the Karlsruhe fuel reprocessing plant (WAK) for monitoring internal air, exhaust air, and off gases is described. Following an explanation of the measuring principles used, operating experience is reported and suggestions are given for future installations. (tr-auth)

21096 (KFK-1899, pp 173-176) SPACE AND AIR MONITORING IN AN INDUSTRIAL LABORATORY. Schulze-Pillot, G. (Farbwerke Hoechst AG, Frankfurt am Main). Mar 1974. (In German).

The experiences obtained in space and air monitoring with a breather system were reported. The measurements were made with flow-through counters in the β laboratories and with a carbon paper filter probe in the γ laboratories. The detection sensitivities and alarm time or different nuclides and activity concentrations were discussed. Corresponding considerations were given for exhaust gas monitoring. (tr-auth)

21097 (KFK-1899, pp 177-181) SPACE-AIR MONITORING IN THE LABORATORIES OF THE JUELICH NUCLEAR RESEARCH CENTER. Jacobs, H. (Kernforschungsanlage, Juelich, Ger.). Mar 1974. (In German).

Due to foresighted monitoring of air in the laboratories of the KFA Juelich, in the past, with few exceptions, no air contamination has been measured which deviates from the natural activity of air. A few positive values lay in the lower half of the control range for maximum allowable concentrations. Experience during ten years in dealing with exposed radioactive materials in the KFA shows that careful monitoring of the breathing air of the employees is, as a rule, unnecessary if effective preventive radiation protection and constant radiation monitoring are assured. (tr-auth)

21098 (UCID-16537) NUMERICAL SIMULATION OF THE TRANSPORT AND DIFFUSION OF NUCLEAR CLOUDS IN 3-DIMENSIONS. Lange, R.; Knox, J. B. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 9 Jul 1974. Contract W-7405-eng-48. 45p. Dep. NTIS $5.25.

A mathematical model, ADPIC, is described for calculating the 3-dimensional distribution of a nuclear cloud or aerosol under both non-scavenging and extended time period precipitation scavenging conditions. The cloud may be the result of a nuclear explosion or a plume containing stack-disposed radioactive waste. The ADPIC results for initially Gaussian, instantaneous, and continuous sources were found to agree with analytic solutions to the diffusion-advection equation to within 5% for six specific cases. The numerical results using ADPIC were compared with regional tracer studies of methyl iodine released to the atmosphere from the National Reactor Test Station. From these observations it was concluded that the principle sources of error result from the objective prescription of the regional flow field, the state-of-the-art prescription of eddy diffusion coefficients as a function of bulk meteorological variables and the sensitivity of the surface air concentration to simplifications made in representing topography in the MATHEW and ADPIC formulations. It should be clear that these sources of error far exceed the sources of error discussed in the comparison of the ADPIC code capability and the analytical solutions. (LCL)

21099 REDISTRIBUTION OF A GAS PLUME CAUSED BY REVERSIBLE WASHOUT. Slinn, W. G. N. (Battelle Pacific Northwest Labs., Richland, WA). Atmos. Environ.; 8: No. 3, 233-239(Mar 1974).

An analytical study is made of the influence on a gas plume of reversible scavenging by rain. The result predicts that at large time, a gas plume will be washed down at a rate $H'J_0$ where J_0 is the rainfall rate and H' is the dimensionless Henry's law constant for the gas. Results are shown for the specific case of an SO_2 plume. (auth)

21100 EVALUATION OF TRIAL MEASUREMENT OF Rn AND ThB GROUND CONCENTRATION IN PRAGUE IN 1970. Kolarova, H. (Inst. of Hydrometeorology, Prague). Meteorol. Zpr.; 26: No. 3, 86-92(26 Jun 1973). (In Czech).

Preliminary results are given of the measurement of the ground concentration of radon, thoron, and their daughters in 1970 in Prague. The research was carried out as part of a complex project called "The study in the pollution of the atmosphere". The investigation of natural radioactivity is to serve as an indicator of the dynamic conditions of the atmosphere, of its degree of stability, and thus also of the degree of industrial pollution. The method of sampling and measuring is described and the mathematical processing of the measured values is dealt with in detail. (Nuclear Sci. Abstr. Czech.)

21101 ^{90}Sr IN ATMOSPHERE-SEA INTERFACE. Timoshuk, V. I. pp 210-217 of Radioekologiya Vodnykh Organizmov. II. Raspredelenie i Migratsiya Radionuklidov v Presnovodnykh Ilmorskikh Biotsenozakh. Andrumaitis, G. P. (ed.). Riga; Izdatel'stvo Zinatne (1973). (In Russian).

A review is given on physico-chemical and biological researches of pre-surface layer, mechanism of vaporization and microconvection in the chilled molecular film, and radioecological research data on surface water microlayer from the estuarine section of Danube using a new design for water sampling. The concentration of ^{90}Sr was observed to be 60 to 90%, in some cases 435%, and it is higher in atmosphere-sea interface than at the bottom. The mechanism of radionuclide concentration in surface microlayer has remained unclear. (auth)

21102 DATA. Section III. Air and Deposition. Radiat. Data Rep.; 15: No. 5 269-279(May 1974).

December 1973 data are presented on the gross β-activity in surface air and precipitation at 68 sampling stations in the US and 24 stations in Canada, and the gross β-activity in surface air only at 12 South American stations and 14 California stations. July through Dec. 1973 data on the gross β-activity of airborne particulates at 6 Mexican sampling stations are tabulated. The ^{238}Pu and ^{239}Pu content of airborne particulates sampled at 11 US stations during January through March 1973 are included. (LCL)

21103 DATA. Section III. Air and Deposition. Radiat. Data Rep.; 15: No. 6, 346-355(Jun 1974).

Data are presented on the gross β radioactivity in surface air and precipitation monitored during January 1974 at 64 US locations, 24 Canadian locations, 12 Pan American stations, and 18 stations in California. The ^{238}Pu and ^{239}Pu contents in airborne particulates sampled at 11 US locations during April through June 1973 are also reported. (LCL)

Soil

21104 (COO-1156-68) PLUTONIUM BEHAVIOR IN THE TERRESTRIAL ENVIRONS OF THE ROCKY FLATS INSTALLATION. Whicker, F. W.; Little, C. A.; Winsor, T. F. (Colorado State Univ., Fort Collins (USA). Dept. of Radiology and Radiation Biology). 1973. Contract AT(11-1)-1156. 15p. (CONF-731117-5; SM-180-45). Dep. NTIS $4.00.

From symposium on environmental surveillance around nuclear installation; Warsaw, Poland (5 Nov 1973).

Pu behavior in the terrestrial environs of the Rocky Flats Plant located between Denver and Boulder, Colo. was investigated by: defining the major components of the terrestrial ecosystem adjacent to Rocky Flats; measuring plutonium in such components in order to quantify plutonium "compartments;" determining intercompartmental transport pathways, mechanisms, and rates; and developing a quantitative model which can be used for conceptual and possibly predictive purposes. The Rocky Flats environs are described, plutonium data gathered to date are summarized, and methods of plutonium surveillance in terrestrial ecosystems are discussed. From the results obtained, it is concluded that soil constitutes the principal Pu reservoir in the terrestrial environs of Rocky Flats, and that although Pu is detectable in all environmental sample material assayed, there is, at present, no evidence of significant biological concentration mechanisms. Further experimental studies are recommended. (LCL)

21105 (RD/B/N-2931) TRANSPORT OF ADSORBING, RADIOACTIVE SPECIES IN A NON-ISOTHERMAL POROUS MEDIUM. Rodliffe, R. S. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Feb 1974. 10p. (RPC/M3FPR/P-(74)3). Dep. NTIS (U. S. Sales Only) $4.00.

The simple parallel circular pore model is used to derive the equation describing the transport of an adsorbing, radioactive species in a non-isothermal porous medium. A temperature gradient is established along the pore axes and the gas and pore surface at any given axial location are assumed to be at the same temperature. The problem is formulated for a single pore and considers the following transport mechanisms: diffusion in the gas in the pore; convective flow of gas in the pore; diffusion along the surface of the pore; adsorption and desorption at the pore surface described by a Henry's Law adsorption isotherm. The surface diffusion and convective terms in the transport equation take the form which would be expected for position dependent diffusion coefficient and velocity. The gaseous diffusion term is significantly different from the form which might be expected from a superficial modification of the relevant equation for an isothermal medium. Under some circumstances the evaluation of experimental concentration profiles using solutions to the isothermal equation will be significantly in error. (auth)

Water

Refer also to abstracts 20653, 21058, 21059, 21178, and 21183.

21106 (AED-Conf-74-157-021) THE MONITORING OF RADIOACTIVE LIQUID EFFLUENTS AT THE KERNFORSCHUNGSZENTRUM KARLSRUHE. Winter, M. 1974. 21p. (In German). INIS.

From seminar on the monitoring of radioactive effluents; Karlsruhe, F. R. Germany (14 May 1974).

3 figs.; 6 tabs.; 5 refs. With abstract in German and English.

Some 4×10^5 m^3 of liquid effluents are produced annually at the Karlsruhe Nuclear Research Center. The activity control measurements performed by the liquid effluents laboratory of the

Radiation Protection and Safety Department decide on the release of these liquid effluents within the meaning of the applicable stipulations. The structure and objectives of liquid effluent monitoring are described. The measurement techniques employed and the extent and results of monitoring measurements are reported. (auth)

21107 (BARC-719) NATURAL RADIOACTIVITY AND GEOCHEMICAL PROCESSES IN THE MARINE ENVIRONMENT OF THE WEST COAST OF INDIA. Joshi, L. U.; Ganguly, A. K. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 183p. Dep. NTIS (US Sales Only) $12.25.

Investigations carried out to study the distribution of the labile component of natural radioactivity in marine sediments and waters along the West Coast of India are reported. Information is presented on: top layer sediments sampling; surface leaching of coastal sediments; ^{226}Ra activity measured in sediments and water; $^{228}Th/^{232}Th$ and $^{230}Th/^{232}Th$ activity ratios in leachates; leaching of uranium isotopes from the sediments; behavior of ^{233}Pa in sediment-seawater environment; thickness of the surface layer containing Th and U, which can be removed by leaching agents without these agents chemically attacking the mineral body of the sediments; and the total amount of Th and U and leachable fractions of Th and U in sediment samples. (LCL)

21108 (CONF-731117-8) EARLY SURVEILLANCE AROUND COASTAL NUCLEAR INSTALLATIONS. Folsom, T. R.; Hodge, V. F. (Scripps Institution of Oceanography, La Jolla, Calif. (USA)). 1973. Contract AT(04-3)-34. 13p. (SM-180/36). Dep. NTIS $4.00.

From symposium on environmental surveillance around nuclear installation; Warsaw, Poland (5 Nov 1973).

Several biological systems have been used to detect extremely small amounts of radioactivity emanating from nuclear reactors that discharge directly into marine environments. Special attention has been given to plutonium. Inorganic absorbing systems, including certain ferrocyanides, provide convenient and sensitive means for monitoring the cesium radionuclides in seawater. These may well be used for monitoring automatically. Generally, the absolute concentrations of radiocaesium can be determined by comparisons with the concentrations of the natural nuclide, ^{133}Cs, that is present in the marine environment at a level that frequently may be predicted. Selected plants have been found most useful, when samplings are normalized against surface area. Certain brown algae are useful for monitoring plutonium, especially nuclide ratios. Silver and cobalt nuclides accumulate preferentially in red algae and marine grasses. Surveillance by means of marine animals is sometimes more sensitive, but proper sampling and interpretations are much more difficult. Several of the common molluscs may be used effectively as monitors of cobalt, silver and other nuclides. Larger fish, whenever their exposure pattern can be estimated, may be exploited for monitoring various metal nuclides through the use of selected organs. Marine biological systems are frequently such sensitive indicators that account must be made of contributions from many sources, even from global fallout more than ten years old. Successful biological surveillance of a given nuclear installation generally requires comparisons of nuclide ratios at several distances using consistent tissues at consistent seasons. (auth)

21109 (GSF-K-73) WATER CYCLE CONTROL WITH RESPECT TO RADIOACTIVE MATERIALS. Aurand, K. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Neuherberg/Muenchen (F. R. Germany). Inst. fuer Strahlenschutz). Feb 1972. 12p. (In German). INIS.

Samplers and sampling methods are described for determining the radioactivity of water resources. (INIS)

21110 ^{90}Sr MIGRATION IN FRESH WATER. Bobovnikova, Ts. I.; Makhon'ko, K. P. pp 30-35 of Radioekologiya Vodnykh Organizmov. II. Raspredelenie i Migratsiya Radionuklidov v Presnovodnykh i Morskikh Biotsenozakh. Andrumaitis, G. P. (ed.). Riga; Izdatel'stvo Zinatne (1973). (In Russian).

Experimental data on the migration of ^{90}Sr deposited from the atmosphere are given. In the middle belt of the USSR about 40% of ^{90}Sr deposited in the soil migrates with rain water, 80 to 90% deposited on the glaciers in the south of the USSR migrates with snow-melt water; sorption of ^{90}Sr by the stream bed before the stream joins the river is about 90%. The beds of rivers give up ^{90}Sr accumulated during the period of decrease in radioactive fallout. During the period from 1962 to 1968 the contribution of ^{90}Sr washing out from the soil to the river water increased from 33 to 66%, and the contribution of fallout decreased from 37 to 4.5%. In 1967 to 1968 the contribution of ^{90}Sr washing out of the soil was ~1 $year^{-1}$ for the zone of sufficient moistening (the Pechora), ~0.2 $years^{-1}$ for the zone of insufficient moistening (the Don), and ~0.35 $years^{-1}$ for rivers of Moscow region. (auth)

21111 EFFECT OF SOME NATURAL FACTORS ON TRANSITION OF ^{90}Sr FROM SOIL SURFACE TO OPEN WATERS. Pisarev, V. V.; Tsybizov, I. S. pp 36-43 of Radioekologiya Vodnykh Organizmov. II. Raspredelenie i Migratsiya Radionuklidov v Presnovodnykh i Morskikh Biotsenozakh. Andrumaitis, G. P. (ed.). Riga; Izdatel'stvo Zinatne (1973). (In Russian).

The results of experiments on the leaching of soils contaminated with soluble ^{90}Sr compounds are reported. It was established that the leaching out of this isotope depends mainly on environmental contamination and the volume of surface water. (auth)

21112 STUDY OF RATIO $^{90}Sr/Sr$ IN LATVIAN SEASIDE LAKE. Leinerte, M. P.; Vadzis, D. R.; Kalnina, Z. K.; Sloke, J. J. pp 73-80 of Radioekologiya Vodnykh Organizmov. II. Raspredelenie i Migratsiya Radionuklidov v Presnovodnykh i Morskikh Biotsenozakh. Andrumaitis, G. P. (ed.). Riga; Izdatel'stvo Zinatne (1973). (In Russian).

Between the content of ^{90}Sr and that of stable Sr there is a direct proportion, the greater the amount of the stable Sr in a substrate, the greater also that of the radioactive Sr. For the macrozoobenthos, macrophytes, fish, and sediments the average concentration factors of the stable Sr are higher than those of ^{90}Sr. Only for plankton an opposite phenomenon was observed; concentration factors of ^{90}Sr are higher than those of the stable Sr. Unconformity of the radioactive and stable Sr content in water organisms and bottom increases during the vegetative period. (auth)

21113 RATIO $^{90}Sr/Sr$ IN PLANKTON OF LATVIAN LAKES OF VARIOUS TYPES. Kalina, Z. K. pp 81-87 of Radioekologiya Vodnykh Organizmov. II. Raspredelenie i Migratsiya Radionuklidov v Presnovodnykh i Morskikh Biotsenozakh. Andrumaitis, G. P. (ed.). Riga; Izdatel'stvo Zinatne (1973). (In Russian).

According to the degree of the specific activity of Sr in plankton, lakes of various trophic types are arranged as follows: distrophic lake > mesotrophic lake > ultraeutrophic lake. In all of them the accumulation coefficients of ^{90}Sr are higher than those of stable Sr. (auth)

21114 ^{90}Sr DISTRIBUTION IN WATER AND BOTTOM SEDIMENTS OF LATVIAN LAKES. Vadzis, D. R.; Kalnina, Z. K. pp 88-95 of Radioekologiya Vodnykh Organizmov. II. Raspredelenie i Migratsiya Radionuklidov v Presnovodnykh i Morskikh Biotsenozakh. Andrumaitis, G. P. (ed.). Riga; Izdatel'stvo Zinatne (1973). (In Russian).

In summer the concentration of ^{90}Sr in the sediments of central lakes has a tendency to decrease. During the vegetative period in littorols a decrease of ^{90}Sr content was observed in coarse sediments, whereas in sandy bottoms the concentration of ^{90}Sr increased. In all lakes an increase of ^{90}Sr content was observed in the period from spring up to the end of the vegetative period. In lakes the distribution of ^{90}Sr between water and the upper sediment layer was observed to be variable. In shallow ultraeutrophic and distrophic reservoirs 65 to 88% the total radiostrontium content was found in sediments and only 12 to 35% in water; in deeper mesotrophic and eutrophic reservoirs only 9 to 25% of the total radiostrontium content was observed in sediments and 75 to 91% in water. (auth)

21115 SORPTION OF ^{90}Sr AND ^{137}Cs BY BOTTOM DEPOSITS OF FRESHWATER LAKE. Lyubimova, S. A. pp 96-101 of Radioekologiya Vodnykh Organizmov. II. Raspredelenie i Migratsiya Radionuklidov v Presnovodnykh i Morskikh Biotsenozakh. Andrumaitis, G. P. (ed.). Riga; Izdatel'stvo Zinatne (1973). (In Russian).

Study of the concentration of ^{90}Sr and ^{137}Cs by lymnetic sediments under the conditions of the experiment showed that these radioisotopes are especially well accumulated and firmly kept by peat and clay sediments. For almost all sediments higher concentration factors and more stable fixation of ^{137}Cs were observed in comparison with strontium-90. (auth)

21116 NATURAL RADIOELEMENTS IN CONTEMPORARY BOTTOM SEDIMENT OF FRESHWATER LAKES OF ESTONIA. Morozova, N. G. pp 116-122 of Radioekologiya Vodnykh Organizmov. II. Raspredelenie i Migratsiya Radionuklidov v Presnovodnykh i Morskikh Biotsenozakh. Andrumaitis, G. P. (ed.). Riga; Izdatel'stvo Zinatne (1973). (In Russian).

Data on the radium and thorium content in bottom sediments of littoral, sublittoral, and profundal zone of Chudskoye and Virtsjarv lakes are presented. It is shown that Ra and Th content in bottom sediment of air-dry matter changes in one-order value [$Th = (0.9-9.2) \cdot 10^{-6}$ g/g; $Ra = (0.1-1.17) \cdot 10^{-12}$ g/g]; the ratio $Th : Ra_u$ changes from 1.6 to 3.6. (auth)

21117 DISTRIBUTION AND MIGRATION OF ^{90}Sr IN EXPERIMENTAL STILL-WATER RESERVOIR. Pitkyanen, G. B.; Safronova, N. G. pp 140-146 of Radioekologiya Vodnykh Organizmov. II. Raspredelenie i Migratsiya Radionuklidov v Pres-

novodnykh i Morskikh Biotsenozakh. Andrumaitis, G. P. (ed.). Riga; Izdatel'stvo Zinatne (1973). (In Russian).

The distribution and migration of ^{90}Sr between the components of experimental freshwater lake were studied. In 10 years after the equilibrium had occurred, the concentration of ^{90}Sr in the water decreased twice. Migration of radiostrontium through the vertical profile of lake sediments was observed. The content of ^{90}Sr in the free swimming green alga Cladophora fructs decreased as well. As for deeprooted Phragmites communis and carp, there were no significant changes in ^{90}Sr concentration. (auth)

21118 ARTIFICIAL RADIOACTIVITY OF SEA WATER AND FOOD HYDROBIONTS OF WORLD OCEAN. Patin, S. A.; Petrov, A. A. pp 200-209 of Radioekologiya Vodnykh Organizmov. II. Raspredelenie i Migratsiya Radionuklidov v Presnovodnykh i Morskikh Biotsenozakh. Andrumaitis, G. P. (ed.). Riga; Izdatel'stvo Zinatne (1973). (In Russian).

Results of long-term radioecological investigations carried out by several institutes of the Ministry of Fisheries of the USSR are considered in connection with the problem of radioactive contamination of World Ocean. Some characteristic trends of change of ^{90}Sr and ^{137}Cs concentrations in sea water are revealed. In the open ocean the concentration of long-lived radionuclides somewhat decreases while in coastal and land water it increases. The levels of radioactive contamination of marine and oceanic hydrobionts change accordingly. Results of about 2000 analyses of the food hydrobionts specimens caught in 1968-1970 showed an increase of artificial radioactivity from oceanic to sea specimens. The characteristic concentrations of radionuclides in the hydrobionts of Atlantic Ocean, Pacific Ocean, Antarctic, and land water are presented. (auth)

21119 ^{90}Sr AND ^{137}Cs IN UPPER LAYERS OF THE BALTIC, NORTH, IRELAND, AND NORWAY SEAS. Buyanov, N. I.; Petrov, Yu. M. pp 218-224 of Radioekologiya Vodnykh Organizmov. II. Raspredelenie i Migratsiya Radionuklidov v Presnovodnykh i Morskikh Biotsenozakh. Andrumaitis, G. P. (ed.). Riga; Izdatel'stvo Zinatne (1973). (In Russian).

The concentration of ^{90}Sr and ^{137}Cs in surface waters of the Baltic, North, Irish, and Norway seas was determined. The concentration of radioisotopes tends to increase slowly on the surface of the Baltic, North, and Norway seas. The conditions under which the radioactive field was formed in the Norway Sea in 1968 and 1970 are considered. (auth)

21120 ^{137}Cs AND ^{90}Sr IN THE SEA OF AZOV. Aleksan'yan, O. M. pp 225-228 of Radioekologiya Vodnykh Organizmov. II. Raspredelenie i Migratsiya Radionuklidov v Presnovodnykh i Morskikh Biotsenozakh. Andrumaitis, G. P. (ed.). Riga; Izdatel'stvo Zinatne (1973). (In Russian).

The results of the research on radioactive pollutions in the Azov Sea in 1970 are presented. It was determined that there is a different content of radioactive isotopes ^{90}Sr and ^{137}Cs in the Azov Sea depending on the region and water salinity. There was a considerable spatial variability of the radioactive concentrations connected with the specifity of physicochemical parameters in different regions of the Azov Sea. (auth)

21121 DATA. Section II. Water. Radiat. Data Rep.; 15: No. 5, 263-267(May 1974).

Data from radiation monitoring during July to October 1973 of drinking and surface water sampled at 76 US locations and of the tritium content in atmospheric precipitation at 19 US locations are presented. (LCL)

21122 DATA. Section II. Water. Radiat. Data Rep.; 15: No. 6, 333-345(Jun 1974).

The following water radiation monitoring data are reported: gross α, gross β, and tritium content in California, Nevada, and Utah drinking water and surface waters sampled during first quarter of 1974; tritium content in drinking water and surface waters sampled at 73 US stations during last quarter of 1973; tritium content in atmospheric precipitation at 19 US cities during last quarter of 1973; and gross β, ^{89}Sr, ^{90}Sr, and tritium content in New York state surface waters sampled during 1972. (LCL)

21123 SIMULATION OF THE FORMS OF THORIUM-230 IN SEA WATER TO STUDY ITS SEDIMENTATION MECHANISM. Kuznetsov, Yu. V.; Komarov, E. V.; Elizarova, A. N.; Simonyak, Z. N.; Bochkov, A. A. Sov. Radiochem. (Engl. Transl.); 15: No. 5, 715-720(1973).

Translated from Radiokhimiya; 15: No. 5, 710-716(1973).

A method is proposed for simulating the forms of existence of ^{230}Th in seawater, based on the introduction into it of uranium in the form of a uranyl carbonate anionic complex with the subsequent formation of ^{234}Th from it. It was shown that the kinetics of sorption on quartz glasses of ^{234}Th introduced into seawater in the form of a neutral solution differ substantially from the kinetics of sorption of ^{234}Th formed in the water itself from uranium. It is suggested that the method proposed for the introduction of ^{234}Th into seawater simulates the process of the formation of ^{230}Th in it most fully. (auth)

Ecosystems and Food Cycles

Refer also to abstracts 21354, 21405, 21422, 21431, 21433, and 21440.

21124 (AEC-tr-7570, pp 102-108) STRONTIUM-90 IN THE BONE TISSUE OF ADULTS AND IN THE TEETH OF PERSONS OF DIFFERENT AGES. Prokof'ev, O. N.; Dzyubenko, I. I.; Dikaya, E. Ya.; Valushkina, N. I.; Antonova, V. A. Jul 1974. Translated from Russian.

In USSR reports on natural and fallout radioactivity.

Data are presented on the content of ^{90}Sr of the bone tissues and teeth of man caused by global fallout during 1965 through 1969. All the data were obtained for the population of cities in the middle part of the USSR (Leningrad, Gor'kiy, Voronezh, and Saratov. (auth)

21125 (CONF-720805-7) SOME EXTREME ACCUMULATIONS OF NATURAL POLONIUM RADIOACTIVITY OBSERVED IN CERTAIN OCEANIC ORGANISMS. Folsom, T. R.; Wong, K. M.; Hodge, V. F. (Scripps Institution of Oceanography, La Jolla, Calif. (USA)). 1973. 31p.

From 2nd conference on natural radiation environment; Houston, Texas, USA (7 Aug 1972).

Results are reviewed from measurement of the content of natural ^{210}Po in seawater samples collected from various locations. Data are presented on the ^{210}Po α activity accumulated by a number of marine plant and animal species in the Pacific Ocean including: the outer surfaces of a giant brown algae from the open ocean and two organisms intimately associated with algae, the abalone and sea hare (Aplysia californica); benthic fishes, including the sable fish (Anoplopoma fimbria) that lives close to the deep ocean floor and presumably feeds on detritus; the albacore (Thunnus alalunga) a migrant predator that inhabits the upper layers of the ocean; zooplankton; phytoplankton; sedentary marine plants, kelp of different ages, crustaceans growing attached to floating scrap wood; the gooseneck barnacle (Pollicipes polymerus) growing attached to pilings at intertidal depths in the surf zone; sea mussels (mytitus sp.); the lanternfish (myctophidae sp.), a mid-water oceanic fish; and dolphins (marine mammals). It was concluded that ^{210}Po accumulates rather remarkably at all trophic levels in the ocean, often without immediate support from ^{210}Pb, its long-lived precursor. (CH)

21126 (RLO-2227-T12-42) LOSS OF ZINC-65 AND MANGANESE-54 FROM THE FRESHWATER MOLLUSC ANODONTA. Harney, P. J. (Oregon State Univ., Corvallis (USA)). June 1974. 116p. Dep. NTIS $9.00.

Thesis.

A comparative field loss study was performed to determine if uptake of ^{65}Zn and ^{54}Mn by the freshwater mollusc Anodonta occurred after shutdown of the plutonium production reactor at Hanford, Washington. Loss rates of these two nuclides were measured in organisms transferred to the non-radioactive Willamette River and compared to loss rates found in organisms remaining in the Columbia River. Resulting ^{65}Zn half-lives of 103 ± 5 days and 135 ± 12 days for transfer and in situ groups respectively indicated that significant uptake took place after shutdown. Periodic sacrifice collections of Anodonta from McNary Reservoir and the estuary further confirmed this finding. Manganese-54 uptake was less dramatic than that of ^{65}Zn. (CH)

21127 (SR-639-14) FLUX OF RADIONUCLIDES THROUGH A SALT MARSH. Progress Report, July 1, 1973-June 30, 1974. Pomeroy, L. R.; Odum, E. P.; Reimold, R. J. (Georgia Univ., Athens (USA). Dept. of Zoology; Georgia Univ., Sapelo Island (USA). Marine Inst.). 10 Jun 1974. 243p. Dep. NTIS $15.25.

The results of mathematical modeling of the flux of phosphorus through the salt marsh and predictions of the results of perturbations of the marsh are reported. Four one-acre watersheds were constructed on Sapelo Island, Georgia. Automatic monitoring equipment was installed at the entrance of each watershed. Automatic sample collection and analysis followed by computerized data reduction generated a large volume of data on which this preliminary data analysis is based. Information is included on: the interaction between mathematical modeling and experimental manipulation of salt marsh watersheds; mineral cycling in marine ecosystems; population estimates for Uca pugnax on the Duplin estuary marsh; and detritus production in coastal Georgia. (LCL)

21128 (TID-3910(Suppl. 9)) TERRESTRIAL AND FRESHWATER RADIOECOLOGY. A Selected Bibliography. Klement, A. W. Jr.; Schultz, V. (Washington State Univ., Pullman (USA). Dept. of Zoology). 1974. 125p. Dep. NTIS $5.45.

A bibliography of 1356 items on terrestrial and freshwater radioecology is presented. A list of 35 bibliographies of literature on related subjects is provided. (LCL)

21129 MIGRATION POSSIBILITY OF RADIONUCLIDES AND THEIR TRANSITION INTO WATER WHEN APPLYING ATOMIC ENERGY FOR PEACEFUL USES. Rovinskii, F. Ya.; Morozova, G. K.; Sinitsina, E. L.; Sinitsin, N. M. pp 20-29 of Radioekologiya Vodnykh Organizmov. II. Raspredelenie i Migratsiya Radionuklidov v Presnovodnykh i Morskikh Biotsenozakh. Andrumaitis, G. P. (ed.). Riga; Izdatel'stvo Zinatne (1973). (In Russian).

Some aspects of primary influence of underground atomic explosion products on aquatic biocenoses were investigated. The effects of nuclide genesis at nuclear explosions and their physicochemical characteristics for transition ability into aquatic ecosystems were studied. It was stated that there is no need for limiting the economic usage of nuclear water reservoirs formed after nuclear explosions, for the concentration of radionuclides in water is lower than the corresponding standards. (auth)

21130 RADIONUCLIDES IN FRESHWATER PLANTS. Kulikov, N. V. pp 44-55 of Radioekologiya Vodnykh Organizmov. II. Raspredelenie i Migratsiya Radionuklidov v Presnovodnykh i Morskikh Biotsenozakh. Andrumaitis, G. P. (ed.). Riga; Izdatel'stvo Zinatne (1973). (In Russian).

Research data on migration and distribution of radionuclides in freshwater plants as well as on the influence of ionizing radiation on accumulation have been discussed. A vast amount of material was collected on the accumulation of radionuclides of many elements by the main forms of freshwater plants depending on a complex of accompanying factors. (auth)

21131 ^{90}Sr IN WATER, SEDIMENTS, AND WATER ORGANISMS IN LATVIAN LAKES OF VARIOUS TYPES. Sloka, J. J.; Kalninya, Z. K.; Vadzis, D. R.; Leinerte, M. P. pp 56-59 of Radioekologiya Vodnykh Organizmov. II. Raspredelenie i Migratsiya Radionuklidov v Presnovodnykh i Morskikh Biotsenozakh. Andrumaitis, G. P. (ed.). Riga; Izdatel'stvo Zinatne (1973). (In Russian).

Concentration factors of ^{90}Sr in plankton, zoobenthos, plants, fish, and sediments of mesotrophic and eutrophic lakes are similar, but appear to be significantly lower than those of distrophic lakes. During the period of maximum development, independently of the trophicity of the lake, the following decreasing series of concentration factors of ^{90}Sr was observed with water organisms: molluska > emerged plants > benthophagous fish > hydrogelophytes > ichthyophagous fish > planktonophagous fish > plankton > benthos. (auth)

21132 ROLE OF WATER PLANTS IN MIGRATION OF STRONTIUM-90 IN SOME RESERVOIRS OF THE LITHUANIAN SSR. Dusauskiene-Duz, N. F.; Marciulioniene, E. D. P.; Neniskiene, V. B.; Jankoviciute, G. J.; Jankevicius, K. K. pp 60-72 of Radioekologiya Vodnykh Organizmov. II. Raspredelenie i Migratsiya Radionuklidov v Presnovodnykh i Morskikh Biotsenozakh. Andrumaitis, G. P. (ed.). Riga; Izdatel'stvo Zinatne (1973). (In Russian).

As a result of experimental and natural investigations of accumulation of strontium-90 by aquatic plants it is ascertained that Charophyte algae are notable for the largest accumulation factor, and phytoplankton and Cladophyte for the smallest accumulation factor. In the process of the experiments the accumulation factor of strontium-90 was of the same order. Removing of strontium-90 from the algae Nitelle sincarpe, Cladophora glomerata, and Fucus vesiculosus indicates that after staying 8 days in clean water the average per cent of strontium-90 left in them is 46 to 60%. Increasing of the concentration of calcium in the water lowers the degree of accumulation and increases the degree of removal of strontium-90 in Elodea. In spite of different capacity for absorption of strontium-90, all investigated water plants play an important role in the migration of the radionuclides in water reservoirs. (auth)

21133 RATIO BETWEEN ^{137}Cs AND K CONCENTRATION FACTORS IN FRESHWATER ORGANISMS. Solyus, A. A. pp 102-107 of Radioekologiya Vodnykh Organizmov. II. Raspredelenie i Migratsiya Radionuklidov v Presnovodnykh i Morskikh Biotsenozakh. Andrumaitis, G. P. (ed.). Riga; Izdatel'stvo Zinatne (1973). (In Russian).

The observed ratio (O.R.) $^{137}Cs/K$ (i.e., the ratio between ^{137}Cs and K concentration factors) was determined in several freshwater organisms from 9 lakes. The obtained values are: in plankton and fish feeding on it: 0.3 to 0.5; in higher plants, molluscs, and fish feeding on bottom organisms: 0.2 to 1.7; in piscivorous fish: 1.0 to 5.0. The O.R. values in freshwater fish seem to be independent of concentrations of K in lake water. (auth)

21134 ENVIRONMENTAL ^{22}Na IN FRESHWATER ECOSYSTEM STUDIES. Flishman, D. G.; Kanevskii, Yu. P. pp 108-115 of Radioekologiya Vodnykh Organizmov. II. Raspredelenie i Migratsiya Radionuklidov v Presnovodnykh i Morskikh Biotsenozakh. Andrumaitis, G. P. (ed.). Riga; Izdatel'stvo Zinatne (1973). (In Russian).

Environmental ^{22}Na may be used to investigate common sodium migration in the biosphere. For several lakes and rivers of the USSR the data, describing ^{22}Na concentration changes in water in 1968 to 1971, were received. According to the data on the environmental ^{22}Na accumulation by some fish and lampreys migrating from sea to lakes and rivers, the values of ^{22}Na biological half-times, estimated for these animals in fresh water, are 15 to 30 days. (auth)

21135 ACCUMULATION OF ^{90}Sr AND ^{137}Cs BY SOME FISH SPECIES IN FRESHWATER RESERVOIRS. Bragin, B. I.; Matmuratov, S. A. pp 123-128 of Radioekologiya Vodnykh Organizmov. II. Raspredelenie i Migratsiya Radionuklidov v Presnovodnykh i Morskikh Biotsenozakh. Andrumaitis, G. P. (ed.). Riga; Izdatel'stvo Zinatne (1973). (In Russian).

The levels of accumulation of ^{137}Cs and ^{90}Sr in seven species of fish from freshwater reservoirs of average mineralization were studied. Dependence of accumulation of ^{137}Cs and ^{90}Sr by freshwater fish on the concentration of potassium and calcium in water circumscribed by equations of regression, obtained from the experimental data, was established. (auth)

21136 K, Rb, AND Cs EXCHANGE DYNAMICS IN FISH AND LAMPREY MIGRATING FROM SEA TO FRESHWATER (BEFORE SPAWNING). Kanevskii, Yu. P. pp 129-135 of Radioekologiya Vodnykh Organizmov. II. Raspredelenie i Migratsiya Radionuklidov v Presnovodnykh i Morskikh Biotsenozakh. Andrumaitis, G. P. (ed.). Riga; Izdatel'stvo Zinatne (1973). (In Russian).

K, Rb, and Cs concentrations in migrating fish (Osmerus eperlanus L.) and lamprey (Lampetra fluviatilis L.) after their arrival in fresh water were measured. It was observed that starving animals do not accumulate K, Rb, and Cs. (auth)

21137 ROLE OF WATER AND FOOD IN UPTAKE OF ^{137}Cs IN FISH ORGANISM. Pakulo, A. G. pp 136-139 of Radioekologiya Vodnykh Organizmov. II. Raspredelenie i Migratsiya Radionuklidov v Presnovodnykh i Morskikh Biotsenozakh. Andrumaitis, G. P. (ed.). Riga; Izdatel'stvo Zinatne (1973). (In Russian).

The absorption of ^{137}Cs by freshwater fish with water, forage, and both water and forage was studied experimentally. The obtained results showed that under the given conditions ^{137}Cs was absorbed by the fish mainly with water (85 to 90%). (auth)

21138 Cs SPECIFIC ACTIVITY DIFFERENCES IN COMPONENTS OF FRESHWATER ECOSYSTEM. Fleishman, D. G.; Kanevskii, Yu. P.; Solyus, A. A. pp 160-168 of Radioekologiya Vodnykh Organizmov. II. Raspredelenie i Migratsiya Radionuklidov v Presnovodnykh i Morskikh Biotsenozakh. Andrumaitis, G. P. (ed.). Riga; Izdatel'stvo Zinatne (1973). (In Russian).

Taking for granted that freshwater organisms receive Cs by food chains it was shown that the observed differences in ^{137}Cs and Cs accumulation by bottom feeders and carnivorous fish are due to the differences in the $^{137}Cs/Cs$ values between water and bottom sediments. (auth)

21139 SOME DATA ON COMPARATIVE EVALUATION OF RADIOACTIVE AND CHEMICAL POLLUTION FACTORS IN FRESHWATER RESERVOIRS. Gus'kova, V. N.; Rodionova, L. F.; Mashneva, N. I.; Kupriyanova, V. M.; Tikhonova, A. I. pp 194-199 of Radioekologiya Vodnykh Organizmov. II. Raspredelenie i Migratsiya Radionuklidov v Presnovodnykh i Morskikh Biotsenozakh. Andrumaitis, G. P. (ed.). Riga; Izdatel'stvo Zinatne (1973). (In Russian).

Experimental study of the effect of radioactive (^{226}Ra, ^{137}Cs, ^{60}Co) and chemical (CH_3HgCl, Co, $H_2N(CH_2)_6NH_2$) contamination of reservoir water showed that these substances have essential discrepancy of stock coefficient relatively to the established standard when considering their influence on aquatic organisms (Daphnia magna, Scenedesmus quadricauda, seaweeds, spawn and larvae of fish) and on the sanitary condition of the reservoir (biochemical consumption of oxygen, development of water microflora). (auth)

21140 ACCUMULATION OF ^{137}Cs BY INDUSTRIAL FISH SPECIES IN THE CASPIAN SEA. Bakunov, N. A.; Panarin, A. P.; Fedotova, L. V. pp 229-234 of Radioekologiya Vodnykh Organizmov. II. Raspredelenie i Migratsiya Radionuklidov v Presnovodnykh i Morskikh Biotsenozakh. Andrumaitis, G. P. (ed). Riga; Izdatel'stvo Zinatne (1973). (In Russian).

Concentration of ^{137}Cs in anchovy in the western part of the Middle and South Caspian is expressed by numbers of one line from 53 up to 97 pC/kg. A clearly expressed difference has been stated in the accumulation of ^{137}Cs in both marine fish and freshwater fish. Maximum accumulation coefficients were observed with the following kinds of marine fish: Caspialosa kessleri, C. caspia, Clupeonella engrauliformis, and Atherina mochen. Freshwater species, Perca fluviatilis L. and Lucioperca lucioperca (L.), are characterized by 2 to 5 times higher accumulation of this radionuclide than other kinds of fish. (auth)

21141 MECHANISMS OF ACCUMULATION OF RADIOACTIVE AND STABLE Sr BY NORTHERN MARINE ALGAE UNDER NATURAL AND EXPERIMENTAL CONDITIONS. Zlobin, V. S. pp 235-241 of Radioekologiya Vodnykh Organizmov. II. Raspredelenie i Migratsiya Radionuklidov v Presnovodnykh i Morskikh Biotsenozakh. Andrumaitis, G. P. (ed.). Riga; Izdatel'stvo Zinatne (1973). (In Russian).

Investigations of the content of radioactive and stable Sr in seawater and algae samples made it possible to determine the average concentration factor (C.F.) of this element under natural conditions: C.F. = 386 ± 275 (n = 12). The C.F. of Fucus vesiculosus at salinity S = 33.295 ‰ is 27, at S = 1.40 ‰ it is 841. Amino acids and some elements have maximum concentration in this alga of S = 7.34 ± 0.69 ‰ (n = 10). In experiments with Ascophyllum nodosum concentration factors of ^{89}Sr varied from 46 to 95 depending on the concentration of stable strontium and calcium. The suppression with NaCN when the concentration of Sr was 2 to 3 mg/l reduced the C.F. by 28 ± 1.4%. (auth)

21142 COMPARATIVE EVALUATION OF ACCUMULATION DYNAMICS OF SOME CORROSION AND FISSION GROUP RADIOISOTOPES AND ALPHA EMITTERS BY NORTHERN MARINE ALGAE. Zlobin, V. S. pp 242-247 of Radioekologiya Vodnykh Organizmov. II. Raspredelenie i Migratsiya Radionuklidov v Presnovodnykh i Morskikh Biotsenozakh. Andrumaitis, G. P. (ed.). Riga; Izdatel'stvo Zinatne (1973). (In Russian).

Concentration factors (C.F.) of ^{60}Co, Fe, and Mn in marine algae Fucus serratus, F. vesiculosus, and Ascophyllum nodosum are considered. The maximum C.F. of F.serratus at the 20th day was 2860, the minimum C.F. of Asc. nodosum, 474. Similar specific differences were found for Fe. From the group of fission products the concentration of ^{91}Y, ^{106}Ru, ^{106}Rh, and ^{137}Cs in seaweeds was studied. C.F. of ^{137}Cs was dependent on the ambient temperature. The behavior of Ru is conditioned by its physical and chemical state when greatly diluted. The comparative data on C.F. of alpha emitters of ^{210}Po, U, and ^{239}Pu are presented as well. Possible mechanisms of mineral metabolism of marine algae are discussed. (auth)

21143 RADIOACTIVE POLLUTION OF INDUSTRIAL WATER ORGANISMS OF WESTERN BASIN. Prokhoycheva, N. P. pp 248-256 of Radioekologiya Vodnykh Organizmov. II. Raspredelenie i Migratsiya Radionuklidov v Presnovodnykh i Morskikh Biotsenozakh. Andrumaitis, G. P. (ed.). Riga; Izdatel'stvo Zinatne (1973). (In Russian).

A study was made on ^{90}Sr and ^{137}Cs content of the tissue of commercial hydrobionts and of the water of the Western basin of the Atlantic by a well-known method using control measurements for checking the validity of the obtained data. The content of these radionuclides in the water is generally below 1 pCi/l^{-1}. Strontium-90 content in the tissue of bony fish is somewhat higher than in that of the cartilaginous ones. Concentration of ^{137}Cs in the muscles of fish is low (2 to 77 pCi/kg^{-1} of fresh tissue). Anthropogenic ray stress from ^{90}Sr with ^{90}Y with ^{137}Cs with ^{137}Ba does not exceed (100 to 200) · 10^{-3} microrem/$hours^{-1}$ which is several thousands times lower than that from the natural radiation sources. (auth)

21144 RADIOECOLOGICAL CONCENTRATION PROCESSES IN LINE WATER–FISH. Teplykh, L. A. pp 257-262 of Radioekologiya Vodnykh Organizmov. II. Raspredelenie i Migratsiya Radionuklidov v Presnovodnykh i Morskikh Biotsenozakh. Andrumaitis, G. P. (ed.). Riga; Izdatel'stvo Zinatne (1973). (In Russian).

Concentrations of K, ^{210}Pb, ^{210}Po, ^{226}Rs, ^{228}Th in ocean water and fish tissue were determined. The concentration of ^{210}Po in fish gonads is higher than in other tissues. ^{210}Po is the basic dose-forming radioisotope. (auth)

21145 ACCUMULATION OF ^{90}Sr, Ca, AND Sr BY FISH IN SEAS AND OCEANS. Shvedov, V. P.; Polikarpov, G. G., Sokolova, I. A. pp 263-268 of Radioekologiya Vodnykh Organizmov. II. Raspredelenie i Migratsiya Radionuklidov v Presnovodnykh i Morskikh Biotsenozakh. Andrumaitis, G. P. (ed.). Riga; Izdatel'stvo Zinatne (1973). (In Russian).

The build-up factor of ^{90}Sr depends mainly on its content in ocean water, the species of fish and the area of fish inhabitation. Build-up factors of stable Ca and Sr differ from that of ^{90}Sr and the discrimination coefficients are accordingly in a somewhat different relationship to factors affecting the build-up factors of ^{90}Sr. (auth)

21146 ACCUMULATION OF RADIOACTIVE AND STABLE Zn BY BLACK SEA ALGAE CYSTOSEIRA BARBATA AND ULVA RIGIDA. Rozhanskaya, L. I. pp 269-273 of Radioekologiya Vodnykh Organizmov. II. Raspredelenie i Migratsiya Radionuklidov v Presnovodnykh i Morskikh Biotsenozakh. Andrumaitis, G. P. (ed.). Riga; Izdatel'stvo Zinatne (1973). (In Russian).

The comparative concentration of radioactive and stable Zn was studied in Black Sea algae Cystoseira barbata and Ulva rigida. Radioactive Zn concentration factors (C. F.) for Cystoseira barbata were 1030 ± 149 and 1100 ± 69, and for Ulva rigida — 670 ± 127 and 660 ± 44. Stable zinc C.F. for Cystoseira barbata were 3290 ± 89 and 1930, and for Ulva rigida — 1980 ± 66 and 1820. The specific activity of Zn in all experiments was less than 1. This testifies to weak exchange in macrophyte structures. (auth)

21147 ^{234}Th ACCUMULATION BY MARINE ORGANISMS. Zesenko, A. Ya.; Nazarov, A. B. pp 274-280 of Radioekologiya Vodnykh Organizmov. II. Raspredelenie i Migratsiya Radionuklidov v Presnovodnykh i Morskikh Biotsenozakh. Andrumaitis, G. P. (ed.). Riga; Izdatel'stvo Zinatne (1973). (In Russian).

Thorium-234 accumulation by 4 species of marine algae, macrophytes, 2 species of zooplankton, and one species of phytoplankton in experimental conditions was studied. The maximum concentration factor (20,000) was found in phytoplankton. Thorium-234 concentration factors were: for Ulva rigida 1200, for Enteromorpha sp. and linza 700 and for Cystoseira barbata 60. The role of surface-active fraction of ^{234}Th in the concentration has been estimated. The data are discussed from the view-point of the organism's participation in the biogeochemical migration of thorium in the ocean. (auth)

21148 MATHEMATICAL MODEL OF ^{90}Sr EXCHANGE BETWEEN CYSTOSEIRA AND MARINE WATER. Egorov, V. N.; Kulebakina, L. G. pp 281-285 of Radioekologiya Vodnykh Organizmov. II. Raspredelenie i Migratsiya Radionuklidov v Presnovodnykh i Morskikh Biotsenozakh. Andrumaitis, G. P. (ed.). Riga; Izdatel'stvo Zinatne (1973). (In Russian).

Using the concept of metabolism in the system ^{90}Sr in marine water-Cystoseira as a chamber structure, a mathematical model of isotopic exchange was developed, which described its dynamics and opened the possibility to biophysical interpretation for concentration phases. It was hypothetically assumed that in the system ^{90}Sr in marine water-hydrobiont 3 chambers existed, one of them containing ^{90}Sr in medium, two others making up the hydrobiont. The exchange in chambers depends on their volume relations and on the exchange constants among them. (auth)

21149 RADIOECOLOGO-BIOCHEMICAL APPROACH TO STUDY OF COBALAMINE CYCLE IN OCEAN. Benzhitskii, A. G. pp 286-294 of Radioekologiya Vodnykh Organizmov. II. Raspredelenie i Migratsiya Radionuklidov v Presnovodnykh i Morskikh Biotsenozakh. Andrumaitis, G. P. (ed.). Riga; Izdatel'stvo Zinatne (1973). (In Russian).

Marine organisms extract intensively cobalt and its artificial radionuclides from sea water. Cobalt is known to be drawn into synthesis of specific cobalt organic compounds of cobalamine type (vitamin B_{12} and its analogs). Transition of mineral cobalt into vitamin B_{12} form increases sharply its migrating abilities. In relatively short-time experiments concentration factors of ^{60}Co in planktonic organisms are measured by tens of units; in natural conditions Co concentration factors make up also values of the order of hundreds (in case of Sagitta up to 10,000) while concentration factors of Co in the content of vitamin B_{12} often amount to hundreds of thousands. Inclusion of Co radionuclide atoms may have greater consequences for the organism than an external gamma ray of equal doses. (auth)

21150 ROLE OF SOME POLYSACCHARIDES OF BROWN ALGAE IN ^{90}Sr EXTRACTION FROM SEA WATER. Ryndina, D. D. pp 295-297 of Radioekologiya Vodnykh Organizmov. II. Raspredelenie i Migratsiya Radionuklidov v Presnovodnykh i Morskikh Biotsenozakh. Andrumaitis, G. P. (ed.). Riga; Izdatel'stvo Zinatne (1973). (In Russian).

Experimental research data are presented on the role of polysaccharides of brown algae, Cystoseira barbata, (alginic acids, fucoidan, and algulose) in ^{90}Sr extraction from seawater. The decrease of ^{90}Sr concentration factors in Cystoseira barbata in decomposition and formation of detritus is stipulated by the decrease of sorption properties of alginic acids with the change of pH of intracellular solutions from 5.87 to 7.4. Fucoidan is

likely to act not only as a concentrator of ^{90}Sr but also as a stimulator of the fixation processes by its alginic acids. The role of algulose in ^{90}Sr concentration is insignificant and makes up 3 to 6% of total quantity taken up by living algae or by products of their decomposition. (auth)

21151 INFLUENCE OF SALINITY AND CONCENTRATION OF Sr AND Ce IN WATER UPON ^{90}Sr ACCUMULATION BY CYSTOSEIRA. Kulebakina, L. G.; Parchevskaya, L. S. pp 305-310 of Radioekologiya Vodnykh Organizmov. II. Raspredelenie i Migratsiya Radionuklidov v Presnovodnykh i Morskikh Biotsenozakh. Andrumaitis, G. P. (ed.). Riga; Izdatel'stvo Zinatne (1973). (In Russian).

Water salinity exerts a reverse influence on the concentration factors (C.F.) of ^{90}Sr by algae. ^{90}Sr concentration factors by Cystoseira are 1.9 times lower for Black Sea water (18‰) than for diluted water (9‰). With the change of water salinity Ca and Sr content in water changes as well, on the concentration of which ^{90}Sr C.F. is dependent. Changing Sr and Ca content in sea water and diluted water, the degree of influence of three factors separately and simultaneously on the value of the concentration factor was studied. Results were treated by the method of total two-factor uniform dispersion analysis. Salinity was found to be a stronger factor than the concentration of Sr and Ca in water. Analysis of Sr, Ca, and the combination of Sr and Ca showed that the influence of Sr addition makes up 35%, Cs 51%, Sr, and Ca 8% and unorganized factors 6% for Black Sea water and for diluted water 59%, 0%, 32%, and 9% respectively. Sr and Ca concentration in Black Sea water and concentration of Sr and both Sr and Ca in diluted water seemed to be influencing factors ($p = 0.99$). Research of frequency distribution of ^{90}Sr C.F. by Cystoseira (dry weight) showed that it was described more exactly by a log-normal curve than by a normal one. (auth)

21152 DATA. Section I. Milk and Food. Radiat. Data Rep.; 15: No. 5, 253-262(May 1974).

Data on the ^{137}Cs and ^{90}Sr content in milk at 63 sampling stations in the US, one is Puerto Rico, one in the Canal Zone, 16 in Canada, and 7 stations in Central and South America are reported for December 1973 and for the 12-month period from January through December 1973. (LCL)

21153 DATA. Section I. Milk and Food. Radiat. Data Rep.; 15: No. 6, 321-332(Jun 1974).

Data on the ^{137}Cs and ^{90}Sr content in milk at 63 sampling stations in the US, 16 in Canada, and 7 stations in Central and South America and Puerto Rico are reported for January 1974 and for the 12-month period from February 1973 through January 1974. Data on the ^{137}Cs, ^{89}Sr, and ^{90}Sr, and tritium content of milk sampled in California, Nevada, and Utah are also included. (LCL)

Radiometric Techniques

Refer also to abstracts 20582, 20589, 20641, and 21128.

21154 (BNWL-SA-5031) EXPERIMENTAL IN-CLOUD SCAVENGING STUDIES AT BATTELLE-NORTHWEST. Hales, J. M. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1974. 2p. (CONF-740635-1). Dep. NTIS $4.00.

From DNA information meeting; Alexandria, Virginia, USA (4 Jun 1974).

In-cloud scavenging experiments with both frontal and convective type storms are discussed briefly. Chemical tracers, mainly indium, were used with the analysis for these tracers performed using neutron activation, atomic absorption, flame emission, or anodic-stripping voltammetry techniques. (LCL)

21155 (IAEA-R-1003-F) APPLICATION OF RADIOTRACERS IN STUDYING THE PERSISTENCE, SORPTION, AND DEGRADATION OF HERBICIDES IN SOIL. Part of Coordinated Programme on Isotope-Tracer Aided Studies of the Origin and Fate of Foreign Chemical Residues in the Agricultural Environment. Final Report, 1 April 1971–31 March 1973. Suess, A. (International Atomic Energy Agency, Vienna (Austria)). Nov 1973. 3p. INIS.

Radiotracer-aided studies were made of the persistence and fate of representative herbicides in soil-plant-systems. ^{14}C-labelled simazine (ring and side chain-labelled) pyrazon and monolinuron (1-^{14}C phenyl and ^{14}C ureido group labelled) were applied to different soils. The role of soil type moisture content and associated microflora were also studied. Using the liberation of $^{14}CO_2$ as an index of herbicide decomposition all herbicides were apparently degraded more rapidly in the relatively acid soil. Bacillus sphaericus present in the treated soil was apparently responsible for a relatively rapid attack on the ureido group of monolinuron with the formation of 4-chloroaniline as the principal metabolite. There was evidence of slower cleavage of the 4-chlorobenzene-ring of the monolinuron. Higher adsorption of monolinuron by the soil was associated with faster degradation but lower uptake by growing plants. Slow cleavage of ^{14}C phenyl-labelled 4-chloroaniline was also demonstrated suggesting ultimately complete degradation of the herbicide. Comparative experiments showed that cleavage of aniline type herbicide metabolites decreased were increasing chlorination so that persistence in soil increased in the order aniline < 4-chloroaniline < 3,4-dichloroaniline. (INIS)

21156 FISSION PARTICLE TRACKS IN MICAS AND MICACEOUS VERMICULITES AS RELATED TO CHEMICAL WEATHERING AND CATION EXCHANGE PROPERTIES. Lee, S. Y.; Jackson, M. L.; Sachs, I. B. (Univ. of Wisconsin, Madison). Soil Sci. Soc. Amer., Proc.; 38: No. 3, 423-428(1974).

Fission particle tracks from ^{238}U impurities in natural micas and micaceous vermiculites were observed by scanning electron microscopy after hydrofluoric acid etching. Track frequency was increased by neutron activation in a thermal nuclear reactor. Without HF etching, the average rate of interlayer K^+ released from micas saturated with UO_2^{2+} and activated, during 6 days depletion in 0.5N $Mg(OAc)_2$ solutions at pH 7 renewed every few min, were 40 to 50% higher than that from nonactivated samples. Activated UO_2^{2+} saturated micaceous vermiculites from Colorado (CO) and Wisconsin (WI) liberated more K, Fe, and $Si(OH)_4$ compared to that from the controls, in 0.5N $Mg(OAc)_2$ at pH 4, renewed frequently. Weathering of micaceous minerals in nature would thus be accelerated by the additional diffusion of interlayer and structural cations through the natural fission particle tracks. The cation exchange capacity (CEC) of the activated micaceous vermiculites after UO_2^{2+} saturation increased from 16 to 25 meq/100g (CO) and from 6 to 12 meq/100g (WI) after the extensive salt treatments involved in CEC measurement, while negligible change in CEC occurred in the CO Na controls and one-third as much change occurred in the WI Na control. The observed higher K^+ selectivity (relative to Ca^{2+}) of the activated samples (0.86 for CO and 1.39 for WI), compared to the controls (0.43 and 1.21, respectively), indicates that activation provided an increase in edge wedge sites for the selective adsorption of fixing cations including the fission product $^{137}Cs^+$. (auth)

21157 AMOUNT AND NITROGEN-15 CONTENT OF NITRATE IN SOIL PROFILES FROM TWO CENTRAL ILLINOIS FIELDS IN A CORN-SOYBEAN ROTATION. Feigin, A.; Shearer, G.; Kohl, D. H.; Commoner, B. (Washington Univ., St. Louis). Soil Sci. Soc. Amer., Proc.; 38: No. 3, 465-471(1974).

The concentration and the $\delta^{15}N$ (per mill ^{15}N excess) of nitrate present in soil cores as a function of depth and time are reported. The cores were taken at approximately monthly intervals from two central Illinois fields which were in a corn and soybean rotation. During the period of October 1971 through April 1972, the mean $\delta^{15}N$ value of nitrate present at all depths of both fields was $+1.2 \pm 1.5$. The most striking variation from this mean occurred after the application, on 4 May 1972, of anhydrous ammonia to the field being sown to corn, when a dramatic decrease was observed in the $\delta^{15}N$ values of the nitrate in the 0 to 30 layer of that field. The difference in the $\delta^{15}N$ values of the nitrate found in the two fields disappeared after about 2 months. The $\delta^{15}N$ values of the ammonium ion found in the soil after application of fertilizer increased with time as the concentration of ammonium decreased and the concentration of nitrate increased. These observations indicate that the observed changes following fertilization in $\delta^{15}N$ of nitrate were due primarily to isotopic discrimination associated with incomplete conversion of ammonium to nitrate. The $\delta^{15}N$ values of the nitrate in both fertilized and unfertilized fields were higher in late summer than in the period October to May. The nitrate content of the 150-cm profile did not show significant variation with time in either field from October 1971 until 4 May 1972, when anhydrous ammonia was applied to the field being sown to corn. The nitrate concentration in the soil profiles of both fields decreased during the period of crop growth. Fertilizer application and crop uptake appeared to exert a larger influence on the total amount of nitrate in the soil profile than did movement of nitrate out of the 150-cm profile by leaching, since rainfall in amounts sufficient to redistribute the nitrate within the profile did not lower the total amount of nitrate in the profile. (auth)

21158 USE OF RADIOCARBON DATING OF ORGANIC MATTER IN THE STUDY OF SOIL GENESIS. Martel, Y. A.; Paul, E. A. (Univ. of Saskatchewan, Sakatoon, Canada). Soil Sci. Soc. Amer., Proc.; 38: No. 3, 501-506(1974).

Radiocarbon dating was used to study the nature and the stability of the organic matter in a range of Chernozemic soils (Borolls) from Saskatchewan. Two catenas, one cultivated, the other not, were studied in detail; the bottom soils of the uncultivated catena contained buried horizons. From the crest of the knoll to the depression, the mean residence time of the surface horizon of the cultivated catena decreased from 545 years before

present (B.P.) to modern, the organic matter content increased and the percentage of hydrolyzable carbon decreased. The content of organic matter decreased but the mean residence time increased by 700 to 4,000 years in the B horizons. Two buried horizons located at different depths underneath the lower members of the uncultivated catena showed mean residence times of 5,950 and 8,410 years B.P. indicating that mass movement of soil had periodically occurred since the last glaciation. The ^{14}C content of a field soil, measured by radiocarbon dating, was compared with the ^{14}C distribution in fractions of another sample of the same soil after amendment with ^{14}C-acetate and 350 days incubation in the laboratory. The artificially labelled soil accumulated more of the tracer in the acid hydrolyzable fractions than was found by radiocarbon dating the field soil. In turn, the distribution of soil nitrogen was more closely associated with the ^{14}C than with the unlabelled carbon of the soil. (auth)

21159 METHODS OF RADIOACTIVE DATING OF EARTH. Rost, R. (Charles Univ., Prague). Vesmir; 52: No. 6, 166-169 (1973). (In Czech).

Methods of absolute dating of the Earth, and of individual geologic formations, such as the potassium–argon, the rubidium–strontium, the helium, the $^{238}U-^{206}Pb$, the zirconium, the radiocarbon, the tritium, the uranium fission tracks methods, and methods based on the decay of uranium are described. The accuracy of dating depends on various instrumental errors, on the laboratory processing of samples, on the effect of the environment of minerals in the course of geological ages, etc. The tolerance of the methods is ±5% to ±10%. (Nuclear Sci. Abstr. Czeck.)

21160 SPACE–AGE DISTRIBUTION OF EPITHERMAL NEUTRONS IN BOREHOLES. Davydov, Yu. B. (Sverdlovsk Mining Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Gorn. Zh.; No. 7, 3-7 (1973). (In Russian).

A problem of cylindrical symmetry in the distribution of epithermal neutrons of spontaneously fissioning uranium in a homogeneous, unlimited medium crossed by circles of a cylindrical borehole was solved. The retardation of the neutrons in the borehole was studied, and age approximations were calculated. Expressions were obtained for the density of retardation of fission neutrons in both media on asymptotes according to age. (tr-auth)

21161 RADIOACTIVE ISOTOPE APPLICATION FOR INVESTIGATION INTO MIGRATION OF MOISTURE AND SOLID PARTICLES IN SOILS, MOBILITY OF MINERAL NUTRIENTS AND THEIR ACCESSIBILITY TO PLANTS. Mel'nikova, M. K. pp 160-167 of Primenenie Izotopov i Yadernykh Izluchenii v Sel'skom Khozyaistve. II. Moscow; Atomizdat (1971). (In Russian)

The migration of salts in homogeneous and stratified solids with different moistures and salinities of the soil, underground leaching, land improvement by silt deposition, the effect of thermal gradients on the migration of soil moisture, and regularities in the behavior of the microquantities of mineral nutrients in the soil and their absorption by plants were studied with radioisotopes. The radioisotope study of the physical chemical laws of the behavior of trace elements in the soils permits a first approximation of judging how the plants will respond to one of several changes in the physical chemical conditions of the soil (will they promote or decrease the absorption of trace elements). This can to a significant degree improve the efficiency of the use of trace fertilizers in different soils. (tr-auth)

21162 USE OF TRITIATED SUBSTRATES IN THE STUDY OF HETEROTROPHY IN SEAWATER. Azam, F.; Holm-Hansen, O. (California Univ., La Jolla, San Diego (USA). Inst. of Marine Resources). Mar. Biol.; 23: No. 3, 191-196(Dec 1973).

3 figs.; 15 refs.

An improved method is described for the study of heterotrophic utilization of dissolved organic substances by marine microorganisms. The method is based on the use of ^{3}H-labelled organic substrates of very high specific activity, rather than the conventionally used ^{14}C-labelled substrates. Direct measurement of the rate of tracer uptake at near ambient concentration can thus be made instead of extrapolation using the Michaelis-Menten equation. The method also permits comparison between the rates of tracer uptake in sub-samples exposed to different physico-chemical conditions (temperature, light, pollutants, etc.) without the necessity of determining the ambient substrate concentration. The method was applied to the determination of D-glucose uptake by nearshore and pelagic natural microbial populations, and was found to be sensitive and convenient. (auth)

21163 MIXING VOLUME CALCULATIONS, SOURCES AND AGING TRENDS OF FLORIDAN AQUIFER WATER BY URANIUM ISOTOPIC METHODS. Osmond, J. K.; Kaufman, M. L; Cowart, J. B. (Florida State Univ., Tallahassee). Geochim. Cosmochim. Acta; 38: No. 7, 1083-1100(Jul 1974).

From panel meeting on interpretation of uranium isotope disequilibrium as a hydrological tracer; Vienna, Austria (5 Mar 1973).

The activity ratio (A.R.) of two naturally occurring isotopes of uranium, ^{238}U and ^{234}U, varies significantly in aqueous environments. The A.R., used in conjunction with the uranium concentration, provides a "fingerprint" of groundwater masses and, by use of these parameters, mixing volumes and flow patterns can be determined. This method was applied to two large limestone springs in central Florida; the mixing volumes and flow patterns calculated are notably similar to those derived by standard hydrologic methods. In deeper parts of the aquifer, the waters are found to have low uranium concentration and a pattern of higher A.R.'s suggestive of an aging effect. (auth)

21164 APPROPRIATE CHOICE OF RADIO-ISOTOPES AND THEIR ACTIVITY FOR HYDROGEOLOGICAL INVESTIGATIONS ACCORDING TO MODEL MEASUREMENTS. Makowski, J. (Polska Akademia Nauk, Gdansk. Instytut Budownictwa Wodnego). Geol. Jahrb., Reihe C; No. 2, 329-337(1972). (In German).

6 figs.; 6 refs.

Hydrogeological and hydrotechnical investigations using radioactive tracer solutions have met with serious difficulties, concerning the choice of adequate radioisotopes to be used in the solution and even more to the selection of appropriate values of minimum radioactivity, necessary to carry through the studies. The attempt made in Poland to develop a standard model design for such preliminary investigations in order to find fully comparable factors for different radioisotopes to be used in tracer solutions with different assumed physico-chemical characteristics of soil and hydraulic pattern is described. Tests were carried out on the basis of this model in columns of various lengths, which resulted in an experimental equation expressing in a simple form the changes in concentration of the radioactive tracer solution along with its flow path. The sole exponential coefficient of this equation gives the total characteristics of the dispersion factors, depending in turn on the type of radioisotopes used, the character of flow and the physico-chemical properties of soil and water medium. (GE)

21165 GROUNDWATER MEASUREMENTS AT THE SITE OF A DAM IN THE DEGENSEEMOOS MOOR NEAR PENZBERG (UPPER BAVARIA). Drost, W. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Neuherberg/Muenchen (F. R. Germany). Inst. fuer Radiohydrometrie). Geol. Jahrb., Reihe C; No. 2, 339-350(1972). (In German).

6 figs.; 7 refs.

In the Degenseemoos moor, a dam was constructed by blasting method as a lateral protection for the planned Autobahn connecting Muenchen to Lindau on Lake Constance. On the side of the dam toward the Autobahn a spring was detected. To clarify the origin of this groundwater flow, velocity and direction of the groundwater movement were measured in the moor and the dam by tracer techniques. The investigation revealed that the spring was not induced by groundwater percolating from the moor into the dam. It was possible to trace the springwater back to confined groundwater from underlying mineral soil and partially to precipitation. (auth)

21166 STRONTIUM ISOTOPE GEOLOGY. Faure, G.; Powell, J. L. Minerals, Rocks, and Inorganic Materials. Monograph Series of Theoretical and Experimental Studies. 5. Isotopes in Geology. New York; Springer-Verlag (1972). 197p.

Information is presented on: the geochemistry of Rb and Sr; measurement of geologic time by the Rb/Sr method; uses of Sr isotopes in petrogenesis; Sr isotopic data for volcanic granitic, alkalic, ultramafic, and sedimentary rocks; isotopic homogenization of Sr in open systems; Rb and Sr in meteorites, $^{87}Sr/^{86}Sr$ ratios in lunar materials; and the evolution of the isotopic composition of terrestrial Sr. An author index, subject index, and a bibliography of more than 480 items are provided. (LCL)

21167 NUCLEAR INDICATORS IN AGRONOMY. Guerin de Montgareuil, P. (CEN de Cadarache, Saint-Paul-les-Durance, France). Sci. Tech. (Paris); No. 11, 27-31(15 Feb 1974). (In French).

From meeting of the consequences of the nuclear technique developments on the daily activity of engineers; Paris, France (20 Nov 1973).

The stable or radioactive isotopes used as tracers represent an essential research tool in many agronomic fields. As an example the study of the oxygen effect, observed in many temperate climate vegetables, and responsible both for atmosphere oxygen content regulation and for a reduction of agricultural productivity, as well as the clearing up by means of Carbon 14 of the chlorophillian assimilation mechanisms, are mentioned. It is also shown how implementation of an advanced technique using computers permits using the information acquired through the nuclear indicators to solve problems such as root excretion of biological fixation of atmospheric nitrogen. (FR)

Site Surveys

21168 (AECL-4758) PRE-IRRADIATION STUDY OF TREE SIZE, AGE, AND GROWTH IN THE FIELD IRRADIATOR-GAMMA AREA. Dugle, J. R.; Thibault, D. H.; Fitzsimmons, W. D. (Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment). May 1974. 55p. Dep. NTIS (US Sales Only) $5.75. AECL $1.50.

Basic data on size, age, and growth of stands of ten species of native trees at a Manitoba, Canada, irradiation field prior to chronic γ irradiation are presented. Height can be predicted from circumference in balsam fir, birch, black ash, aspen, balsam, poplar, jack pine, white spruce, upland black spruce, bog black spruce and larch. Age can be predicted from either circumference or height in balsam fir, aspen, white spruce, bog black spruce, and larch. In black ash, age can be predicted from circumference and in jack pine, age can be predicted from height. Some influences of environmental factors were noted between stands. (auth)

21169 (ANL/ES-40(Vol.9)) ENVIRONMENTAL STATUS OF THE LAKE MICHIGAN REGION. Volume 9. Soils of the Lake Michigan Drainage Basin: An Overview. Stearns, F.; Hole, F. D.; Klopatek, J. (Argonne National Lab., Ill. (USA)). Jun 1974. Contract W-31-109-eng-38. 22p. Dep. NTIS $4.00.

Existing information on soils of the Lake Michigan Drainage Basin is summarized. Soil functions, morphology, classification, and land-capability scheme are described in the text. Distribution of major soil groups is compiled for the basin area, wherein, the Podzols soil group is most abundant. The Brown Podzols account for about 46% of the basin area, and another 30% of the basin land is composed of Gray-Brown Podzols. Under favorable climatic conditions, forest land has been converted to agricultural land. However, forests appear to be prevalent and comprise the major land use of the basin soils. Agriculture ranks second. Increasing urbanization also has made its impact on soil use within the basin. In these urbanized areas soils are now covered largely by asphalt and concrete constructions. (auth)

21170 (BMI-171-155) AMCHITKA BIOENVIRONMENTAL PROGRAM. Studies of the Avifauna on Amchitka Island, Alaska. Final Progress and Summary Report, August 14, 1967–September 30, 1973. Williamson, F. S. L.; White, C. M. (Battelle Columbus Labs., Ohio (USA)). Aug 1974. Contract AT(26-1)-171. 38p. Dep. NTIS $5.00.

This study, conducted between 1967 and 1973, concentrated on the distribution and composition of Amchitkan avifauna, breeding densities, and other ecological and biological considerations. As of September, 1973, 126 species had been recorded on Amchitka; of these 28 were known to have bred there. The most numerous of the birds was the Lapland Longspur with about 10,000 breeding pairs which made up more than 65 percent of the birds breeding annually on the Island. This averages to about 37 pairs per 100 acres. Other important terrestrial breeders were Rock Sandpipers, 3 pairs per 100 acres, and Rock Ptarmigan, 1.3 pairs per 100 acres. Waterfowl were abundant both in marine and freshwater habitats. In summer many freshwater lakes were used; in the fall most of the waterfowl observed in freshwater habitats were concentrated on less than 1 percent of the lakes. Cliffs that encircle much of Amchitka were used by nesting birds of which about 55 pairs of Bald Eagles, 18 pairs of Peregrine Falcons, and 500 pairs of cormorants nested annually. About 200 eagles and 50 falcons occurred on the Island during the summer. Both species derived most of their food from the marine environment. The discovery of breeding Aleutian Terns in 1968 was significant for there was no previous record of their breeding west of Umnak Island. Of the fourteen ecological formations characterized during this study, only two marine and three terrestrial formations were the most significant to avifauna utilization. Data on the feeding ecology of birds showed that, except for some vegetative matter eaten by finches, ptarmigans,and some waterfowl species, the main food resources for all species was derived from the marine environment. The immediate effects of Milrow were minimal; the more extensive Cannikin effects resulted in the known death of 17 birds, damage to 2 falcon eyries, and the destruction of 6 eagle nests. Other effects related to human activity as a result of the testing program are discussed. (auth)

21171 (BNWL-1640) HANFORD WIND STORM OF JANUARY 11, 1972. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Feb 1972. Contract AT(45-1)-1830. 40p. Dep. NTIS $5.00.

Data recorded by wind sensors at the AEC's Hanford Reservation during a storm on Jan. 11, 1972 are reported. The highest hourly average was 51 mph and the peak gust was 80 mph. (LCL)

21172 (DPSPU-54-11-12) HEALTH PHYSICS SITE SURVEY DATA, JANUARY TO JULY 1953. Albenesius, E. L. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Atomic Energy Div.). 1 Apr 1954. 32p. Dep. NTIS $4.75.

The period from January 1953 to July 1953 marked a time of transition in the site survey program at the Savannah River Plant. With the plant background survey program essentially complete, and with startup of operations with respect to major sources of site contamination limited to two locations (CMX-TNX and the 300 Area), the program became one of routine site monitoring on a reduced scale. Two exceptions to this are noted in two special studies carried out during this period. The first study covers a survey of the area around CMX-TNX following the explosion which occurred there in January 1953, spreading uranium contamination over a wide area east of that facility. The second special study is an evaluation of the amount of uranium carried off in the 300 Area effluent system from its startup, in October 1952, to February 1953, a period of 16 weeks. An estimated 100 pounds of natural uranium was discharged during this period. Partial occupancy of the permanent 735-A facility was effected in February 1953. Setting up of the new counting room and laboratory units continued throughout the spring months. In addition to analysis of routine samples and the special analyses carried out in conjunction with the two special studies, the laboratories concentrated on procedure development to meet needs of the site survey program under conditions of full plant operation. A special study was made of particulate air-borne activity due to the Nevada AEC tests. Essentially all of this activity was accounted for by fission products of barium, strontium, molybdenum, and the rare earths. (auth)

21173 (DUN-1409) SEISMOLOGY REPORT ON WASHINGTON, IDAHO, NORTHERN OREGON AND WESTERN MONTANA, AND THE HANFORD AREA, WASHINGTON. Rasmussen, N. H. (Douglas United Nuclear, Inc., Richland, Wash. (USA)). 3 May 1966. 17p. Dep. NTIS $4.00.

Tabulated data are presented on the location and intensity of earthquakes of intensity VI or greater which occurred in Washington, Idaho, northern Oregon, and western Montana during the period from 1865 through 1965, and on all earthquakes recorded in the general Hanford area during the same period. Since no shock of magnitude greater than 5.8 or of mm intensity greater than VII has occurred in the Hanford area in at least 100 years, it is concluded that none should be anticipated during the next 50 to 100 years. (LCL)

21174 (DUN-1410) GEOLOGY AND TECTONIC HISTORY OF THE HANFORD AREA AND ITS RELATION TO THE GEOLOGY AND TECTONIC HISTORY OF THE STATE OF WASHINGTON AND THE ACTIVE SEISMIC ZONES OF WESTERN WASHINGTON AND WESTERN MONTANA. Jones, F. E.; Deacon, R. J. (Douglas United Nuclear, Inc., Spokane, Wash. (USA)). 15 Jun 1966. 258p. Dep. NTIS $16.00.

21175 (LA-5636-MS) WATER SUPPLY AT LOS ALAMOS DURING 1973. Purtymun, W. D.; Herceq, J. E. (Los Alamos Scientific Lab., N. Mex. (USA)). Jun 1974. Contract W-7405-eng-36. 30p. Dep. NTIS $4.00.

The Los Alamos water supply for 1973 consisted of 1566 million gal from 16 wells in three fields, with an additional 49 million gal from a gallery in Water Canyon. Water level trends in the well fields were as anticipated for current pumpage practices. Recommendations previously made in Los Alamos Scientific Laboratory reports LA-5039-MS and LA-5296-MS for a new well for the Pajarito field and a replacement well in the Guaje field are still valid. An exceedingly dry spring and summer or an outage of a high-yield well during the period of heavy pumpage could result in a shortage of supply for an indefinite period of time. Monthly pumping and production data are presented for each of the 16 wells and the gallery in Water Canyon for the years 1971, 1972, and 1973. (auth)

21176 (ORO-4180-4) DYNAMICS AND METHODS INVOLVED IN THE REVEGETATION OF AMCHITKA ISLAND. 1. Revegetation of Damaged Areas. 2. Primary Consumer Effects on Vegetation. Annual Report, January 1, 1973–April 1, 1974. Amundsen, C. C. (Tennessee Univ., Knoxville (USA)). Apr 1974. Contract AT(40-1)-4180. 51p. Dep. NTIS $5.75.

Studies were undertaken to determine the pattern and processes of vegetational recovery on damaged tundra landscapes of Amchitka Island, Alaska. Twenty throusand plus data points were taken and the data were analyzed for plant distribution percentages and for each category of site characteristics (disturbance type, history, exposure, slope, aspect), for correlations among species and among site factors and species, and by regression analyses for species relationships with site factors. Three nuclei of incipient plant communities were identified, but no ruderal plant communities were delineated by the data, and no plant assemblages were associated with a specific chronological place in a succes-

sional sere. Although orderly seral succession does not occur, vegetational recovery does. Recovery depends upon the texture of the disturbed substrate, the sexual reproduction of nearby plants, the spreading behavior of adjacent plants, or the survival of underground plant parts capable of regeneration. Artificial manipulations (reclamation) may not always promote more rapid recovery. The food habits of the brown rat include grazing of vascular plants on Amchitka. Invertebrate defoliation can also be identified. These studies indicate that although a significant number of the inland rat population do eat vegetation, and there are grazing invertebrates, consumption of vascular plants does not affect the distribution of individual plant species or the composition of the plant communities and the impact of grazing on vegetation is minimal. The role of primary consumers is considered in terms of the terrestrial ecosystem to be insignificant. (auth)

21177 (RLO-2225-T-25-12) COLUMBIA RIVER EFFECTS IN THE NORTHEAST PACIFIC: PHYSICAL OCEANOGRAPHY. Report of Progress, September 1971–January 1974. Smith, J. D.; Hickey, B.; Beck, J. R. (comps.). (Washington Univ., Seattle (USA). Dept. of Oceanography). 13 May 1974. Contract AT(45-1)-2225. 397p. Dep. NTIS $23.00.

Research in physical oceanography conducted on Columbia River effects in the Northeast Pacific Ocean from Sept. 1971 through Jan. 1974 is summarized. The primary effort has been directed toward procuring long term series direct current measurements during the winter and summer at one station on the central continental shelf and one station on the shelf edge. The field experiments, data processing procedures, and results are discussed. (LCL)

21178 (SZS-156) RADIATION PROTECTION CRITERIA FOR THE EVALUATION OF GEOHYDROLOGIC CONDITIONS OF NUCLEAR PLANT SITES. Koerner, W.; Murgiat, J.; Hannemann, M. (Staatliche Zentrale fuer Strahlenschutz, Berlin (German Democratic Republic)). Apr 1974. 23p. (In German). Dep. NTIS (US Sales Only) $4.25.

Radiation protection in the evaluation of nuclear plant sites necessitates the assessment of the risk of ground water contamination resulting from possible tank leakages. In general, this assessment can be performed on the basis of the results of the conventional geological survey without additional exploration. The essential aspects of a corresponding expertise are formulated. The principles of radionuclide migration in the saturation zone and the aeration zone are presented in a simplified form and applied by way of example. (auth)

21179 (UCID-16565) FINAL REPORT ON ENVIRONMENTAL DEFINITION PROGRAM FOR PERIOD ENDING JUNE 30, 1974. Knox, J. B.; Lovill, J. E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 25 Jul 1974. Contract W-7405-eng-48. 12p. Dep. NTIS $4.00.

Satellite monitoring of the stratosphere and troposphere is conducted at the Lawrence Livermore Laboratory to provide thousands of vertical profiles each day of temperature, water vapor, ozone, ice and liquid cloud contents, and various discrete radiational emission spectra. The data acquired and computer codes being developed to analyze the data are discussed. (LCL)

21180 (UCRL-51592) GEOLOGICAL AND SEISMOLOGICAL INVESTIGATION OF THE LAWRENCE LIVERMORE LABORATORY SITE. Wight, L. H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 3 Jun 1974. Contract W-7405-Eng-48. 43p. Dep. NTIS $4.00.

In response to an AEC request for Safety Analysis Reports for all critical structures on the Lawrence Livermore Laboratory site, the seismic hazard at LLL was examined. The geology and seismology of the Livermore Valley and surrounding regions are reviewed and all the active faults in the region based on seismic history, geomorphology and geodetic data are identified. After carefully estimating the accelerations that the site would experience from maximum magnitude earthquakes on each active fault, it was concluded that the Tesla fault has the most potential for doing damage at the LLL site. The response spectrum is derived. (auth)

Thermal Effluents

21181 (SRO-819-1) REPORT OF ECOLOGICAL RESEARCH AT SAVANNAH RIVER ECOLOGY LABORATORY. Annual Report, August 1971–May 1, 1974. Lewis, W. M.; Smith, M. H.; Beyers, R. J.; Gentry, J. B.; Gibbons, J. W.; Howell, F. G.; O'Farrell, M. J.; Sharitz, R. R. (Savannah River Ecology Lab, Aiken, S. C. (USA)). 31 May 1974. Contract AT(38-1)-819. 96p. Dep. NTIS $8.00.

Research emphasis at the Savannah River Ecology Laboratory has focused on the effects of thermal effluents and the cycling of stable and radioactive elements in natural systems. These research efforts are strengthened by establishment of a foundation of basic ecological information from previous and on-going studies. On the basis of findings in the mineral cycling program the roles of plants and animals in elemental transport have been evaluated in a variety of ecosystems. Trophic transfer relationships have been determined in a variety of biological circumstances, particularly for radiocesium. The thermal program has stressed the determination of population and community responses to both high and low temperature inputs in natural environments. These findings are discussed and interpreted within the framework of basic environmental information obtained in concurrent SREL studies. (auth)

21182 EFFECTS OF THERMAL DISCHARGES FROM THE NUCLEAR POWER INDUSTRY. Clarke, H. A. (Ministry of the Environment, Toronto). pp Paper No. CNA'73-304 of Proceedings of the Thirteenth Annual International Conference of the Canadian Nuclear Association. Toronto; Canadian Nuclear Association (1973).

From 13th annual international conference of the Canadian Nuclear Association; Toronto, Ontario (17 Jun 1973).

The extent to which the ecology of Lake Ontario may be affected or upset by large discharges of waste heat from nuclear power reactors and thermal stations is discussed on the basis of Ontario Hydro's present rate of load growth for the next two decades. Rather than considering the long term temperature rises for the entire body of the lake, ecological changes are assessed from the point of view of localized in-shore heating. These localized effects on the water body are governed by the three interrelated processes of "mixing", "stratification" and "atmospheric transfer". Temperature changes affect the physical properties of water upon which aquatic life depends and can cause significant alterations in oxygen content, metabolic rates, waste oxidation and growth and death rates. Biological effects are assessed in terms of shifts of population structures aquatic food webs, lethal and sublethal temperature responses, decreased resistance to toxic substances, acclimatization abilities and avoidance reactions. (CA)

Chemical Effluents

Refer also to abstracts 20579 and 21172.

INSTRUMENTATION

Radiation Detection Instruments

Refer also to abstract 22226.

General Detectors and Monitors

Refer also to abstracts 21087, 21442, 21444, 21479, 22734, and 22809.

21183 (AD-776254/5) INSTRUMENTATION RESEARCH FOR RADIATION MEASUREMENTS IN THE MARINE ENVIRONMENT. Final Report, 1969–1973. Folsom, T. R. (Scripps Institution of Oceanography, La Jolla, Calif. (USA)). Feb 1974. Contract N00014-69-A-0200-6011. 10p. (SIO-REF-74-4). NTIS $3.00.

Four years continuance of research into the behavior of minute traces of artificial and natural radioactivity in the ocean and development of means for detecting and measuring extremely small changes of ionizing radiation in the marine environment are summarized. (auth)

21184 (AED-CONF-74-042-006) DEVELOPMENT OF AN X-Y-MULTIWIRE PROPORTIONAL COUNTER (MWPC) FOR THE MAGNETIC SPECTROGRAPH OF THE JUELICH CYCLOTRON. Koehler, M.; Mueller, K. D.; Teske, M. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Zentrallabor fuer Elektronik). 1974. 4p. (In German). INIS.

From spring meeting of the expert committee on nuclear and high energy physics of the Deutsche Physikalische Gesellschaft e.V.; Bochum, Germany (4 Mar 1974).

The development of a spatial resolution multiwire proportional chamber system is described which should meet the following demands: detection of charged particles (e.g., p up to 45 MeV, d up to 90 MeV, α up to 180 MeV) with a spatial resolution of about 0.5 mm. The sensitive area should be 100×5 cm^2. Identification of particles should be possible as well as coincidence measurements with γ-detectors. (INIS)

21185 (AED-Conf-74-042-013) A THIN PARALLEL PLATE COUNTER FOR FAST TIME SIGNALS. Ettling, K.; von Witsch, W. 1974. 1p. (In German). INIS.

From spring meeting of the expert committee on nuclear and high-energy physics of the Deutsche Physikalische Gesellschaft e.V.; Bochum, F. R. Germany (4 Mar 1974).

Abstract only.

A thin counter with parallel plates is described, which delivers a fast time signal independent of the kind and energy of the incident charged particle. Counter area and thickness can be largely adjusted to various measuring purposes. Up to now, counters for fast proton detection with a counting area of 4 cm^2 and a thickness of 1.5 mg/cm^2 have been built. For heavy ion spectroscopy with smaller counter areas the thickness is readily reduced. The efficiency for alphas and heavy particles is practically 100%. Time resolutions of some 100 psec are attainable without difficulty. (GE)

21186 (AERE-R-7250) ROTATING DRUM CLOTHING MONITOR FOR THE DETECTION OF RADIOACTIVE NUCLIDES INCLUDING ^{239}Pu. Stevens, D. C.; Churchill, W. L. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). May 1974. 14p. Dep. NTIS (US Sales Only) $4.00. UK 50 pence.

In laundries where protective clothing contaminated with radioactive material is washed it is desirable to have some means of measuring the levels of radioactive contamination on the clothing before its return to the users. Monitoring of individual garments is a very time consuming operation and there is a need for a monitor that will allow a rapid throughput of clothing and detect as many radionuclides as possible. An instrument is described which measures the total contamination on a 4 kg batch of clothing packed in a cylindrical cardboard drum which is rotated while a NaI(Tl) scintillation counter scans along its length. The sensitivity of the instrument to various radionuclides has been measured and the results discussed in terms of the maximum permissible levels of surface contamination for protective clothing. Some suggested values for the derived working levels (dwl) of contamination for bulk clothing measurements are given. At the suggested dwl, most of the commonly occurring nuclides such as ^{239}Pu, ^{137}Cs, ^{90}Sr and ^{60}Co can be determined to a 95% confidence limit of better than ±20%. During one year of operational use it has been shown that a monitoring rate of about 160 kg h^{-1} can be obtained which reduces the monitoring time compared with conventional method by a factor of about 5. (auth)

21187 (BARC-752) NEUTRON FLUX MAPPING AT APSARA REACTOR USING SOLID STATE TRACK DETECTORS. Srivastava, D. S.; Sampathkumar, R.; Chaudhuri, N. K.; Iyer, R. H. (Bhabha Atomic Research Centre, Bombay (India). Radiochemistry Div.). 1974. 20p. Dep. NTIS (US Sales Only) $4.00.

The fission track registration technique has been shown to be a very simple, inexpensive and accurate method for neutron flux measurements. Dielectric plastics, mica and uranium-doped glass have been used for this purpose. The use of the polycarbonate plastics, mica and glass for the measurement of thermal and fast flux distribution in the thermal column and in different positions in the core of the APSARA reactor is described. Some local microscope slide glasses were also standardized by simultaneous irradiations with standard GEC glass. It is demonstrated that solid state track detectors immersed in fissile material solutions of suitable concentration can serve as an elegant and versatile tool for neutron dosimetry. Convenience of this technique over other methods and the various factors determining the accuracy are discussed. (auth)

21188 (CEA-R-4580) CALIBRATION OF A LARGE AREA PROPORTIONAL COUNTER FOR ^{239}Pu X-RAY DETECTION IN LUNGS. Daburon, M. L.; Jeanmaire, L. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)). Jul 1974. 34p. (In French). Dep. NTIS (US Sales Only) $4.75.

A method was developed for the calibration of a proportional counter for use in measurements of ^{239}Pu in the lung. The difference of absorptions of the 60 keV ray of ^{241}Am from an external source by an individual and a phantom was used for the calibration. The difference was converted into soft tissue (muscle) equivalent thickness, allowing the phantom calibration factor to be corrected for each subject. As an anthropomorphous phantom was used, an equivalent absorption of chest bones and lung is assumed for the subject and the phantom. The calibration factor, for an average-sized individual is 58 counts per minute for 1 μCi of ^{239}Pu in the lung. (auth)

21189 (JINR-D13-7616, pp 337-341) SOME SPECIAL ELECTRONIC MODULES FOR PHYSICAL EXPERIMENTS. Hajduk, Z.; Turala, M. (Inst. of Nuclear Physics, Krakow). 1974.

From 7th international symposium on nuclear electronics; Budapest, Hungary (17 Sep 1973).

Three units in the CAMAC standard are briefly described: (1) multiscaler with analog display which can be used for measuring delay coincidence curves, beam profiles, the ratio of counting rates, etc.; (2) six-decade scaler with decimal digital display for measuring the efficiency of detectors, delay coincidence curves, noise, frequency, time, etc.; and (3) stabilized high voltage power supply for photomultipliers and/or proportional counters. (WHK)

21190 (JINR-D13-7616, pp 342-348) TRIGGER SYSTEM FOR THE SELECTION OF SCATTERING EVENTS IN THE REAL TIME SCALE OF THE EXPERIMENT. Kamuk, A. P.; Samsonenkov, V. S.; Sumar, V. A. (Inst. of Nuclear Physics, Leningrad). 1974. (In Russian).

From 7th international symposium on nuclear electronics; Budapest, Hungary (17 Sep 1973).

In order to improve the Vorob'ev method, to increase the rate of assembling statistics, and to exclude the background of nuclear reactions occurring in gas targets and on the electrodes of ionization chambers under the influence of phonons and neutrons and to separate the inelastic reactions with the creation of mesons, it was proposed to use a proportional chamber for the selective triggering of an ionization chamber. The design and characteristics of the triggering system fabricated are described in detail. A structural circuit is given of the triggering system. (JSR)

21191 (JINR-D13-7616, pp 349-357) TWO-PARAMETER PULSE-HEIGHT ANALYSIS USING CAMAC PROCESSOR. Starzynski, A.; Michalski, M. (Inst. of Nuclear Research, Swierk, Poland). 1974.

From 7th international symposium on nuclear electronics; Budapest, Hungary (17 Sep 1973).

A CAMAC system for two-parameter spectral analysis is described. The data may be stored on magnetic tapes and processed off-line, or it may be real-time processed. An example of application described is a program for particle identification and spectra measurements of fission fragments using an E-ΔE telescope counter. (WHK)

21192 (JINR-D13-7616, pp 365-367) SIX-CHANNEL FAST DISCRIMINATOR WITH MEMORY. Rushovski, Ch. 1974. (In Russian).

From 7th international symposium on nuclear electronics; Budapest, Hungary (17 Sep 1973).

A discriminator working with pulses from a scintillation counter in a hodoscopic system is described. One of the channels of the discriminator is shown and briefly discussed. (JSR)

21193 (JINR-P-13-7098) WORKING CONFERENCE ON SEMICONDUCTOR DETECTORS, JULY 21–23, 1972, DUBNA. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1973. 105p. (In Russian). (CONF-720743-).

A separate abstract was prepared for each of the 11 papers presented at the conference. (WHK)

For abstracts of individual papers see: 21194–21203 and 21237.

21194 (JINR-P-13-7098, pp 5-8) EFFECT OF SOME GROWTH CONDITIONS OF GERMANIUM MONOCRYSTALS ON THE CHARACTERISTICS OF LITHIUM-DRIFTED DETECTORS. Goncharov, L. A.; Chavleishvili, N. G.; Novikov, S. R.; Shishkina, G. A. 1973. (In Russian).

From working conference on semiconductor detectors; Dubna, USSR (21 Jul 1972).

The effect of oxygen removal during the production of the original Ge on the characteristics of Li-drifted detectors was studied in conjunction with the study of the characteristics of detectors from a Ge sample used for alloying. The experimental data are tabulated and show that superheating of the melt in a vacuum for 5 min is sufficient to guarantee a high drift mobility of the Li. Extended superheating impairs the value of the parameter R/τ, where R is the parameter characterizing the inhomogeneity of the material with respect to the charge loss and τ is the lifetime of the current carriers. Control of the specific resistance at −60°C appears to be the controlling condition in the original material. (JSR)

21195 (JINR-P-13-7098, pp 9-15) SOME OPTICAL AND RECOMBINATION CHARACTERISTICS OF GERMANIUM USED FOR THE PREPARATION OF Ge(Li) DETECTORS. Gavrilov, G. M.; Goncharov, L. A.; Litovchenko, P. G.; Petrosyan, E. E.; Ukhrin, Ya.; Chukichev, M. V. 1973. (In Russian).

From working conference on semiconductor detectors; Dubna, USSR (21 Jul 1972).

The infrared transmission, life of the charge carriers, energy of ionization, absorption coefficient, and energy resolution were measured for samples of p-type Ge of 10-mm thickness with the surface parallel to the (111) plane. (JSR)

21196 (JINR-P-13-7098, pp 16-27) RELATION OF THE PARAMETERS OF THE ORIGINAL CRYSTALS WITH THE CHARGE COLLECTION IN GERMANIUM LITHIUM-DRIFTED DETECTORS. Kotina, I. M.; Novikov, S. R.; Sedov, N. Ya.; Shishkina, G. A. (Inst. of Nuclear Physics, Leningrad). 1973. (In Russian).

From working conference on semiconductor detectors; Dubna, USSR (21 Jul 1972).

The lifetime of minority charge carriers at low temperature and their homogeneity across the ingot, the size of the impurity photocurrent of diodes prepared from the crystals studied, and the dislocation density were measured in the original crystals. The data obtained were compared with the results of the determination of the lifetime of charge carriers in the working volume of the detector and the homogeneity of the charge collection in the detector. (JSR)

21197 (JINR-P-13-7098, pp 28-31) CHARGE LOSS IN SURFACE-BARRIER GOLD-SILICON COUNTERS. Afanas'ev, V. F. (Inst. of Nuclear Physics, Leningrad); Afanas'eva, N. P.; Tsvetnikova, T. A.; Strokan, N. B.; Tisnek, N. I. 1973. (In Russian).

From working conference on semiconductor detectors; Dubna, USSR (21 Jul 1972).

The existence in the volume of the silicon of structure imperfections completely determines the value of the resolving capacity of the detector. The inhomogeneity of these imperfections can possibly be controlled by the method of local photoconductivity in conjunction with the four-zone method for the determination of the coefficient of variation of the specific resistance in the original Si. By use of the correlation between the dislocation density and the excess noise level it is possible to predict the quality of the detector obtained from a given stock material. (tr-auth)

21198 (JINR-P-13-7098, pp 32-40) STUDIES MADE BY THE SEMICONDUCTOR DETECTOR GROUP OF THE JINR ON THE DEVELOPMENT AND PREPARATION OF SEMICONDUCTOR DETECTORS. Beregi, E.; Vylov, Ts.; Egoshin, I. N. 1973. (In Russian).

From working conference on semiconductor detectors; Dubna, USSR (21 Jul 1972).

Data on the preparation and properties of Ge detectors with volumes from 0.5 to 70 cm^3, Si surface-barrier detectors with working areas of 0.5 to 12 cm^2, Si(Li) detectors with primary sensitive range up to 5 mm, and ΔE detectors of thickness up to 15 μm with working surface up to 1 cm^2 are briefly presented. (JSR)

21199 (JINR-P-13-7098, pp 41-50) RADIATION SEMICONDUCTOR COUNTER IN THE INSTITUTE OF NUCLEAR RESEARCH IN SVERK. Bel'tsazh, E.; Dombrovski, A.; Lekhovich, T.; Slapa, M.; Khvashchevska, Ya.; Charnatski, V.; Shimchak, M. (Inst. of Nuclear Research, Sverk, Poland). 1973. (In Russian).

From working conference on semiconductor detectors; Dubna, USSR (21 Jul 1972).

At the Institute of Nuclear Research studies on radiation detectors have centered on three areas, i.e., development of counters of cadmium telluride, use of the implantation method for the preparation of counters from n-type Si, and improvement of the parameters of radiation spectrometers with detectors of the Si(Li) and Ge(Li) type. The most important results obtained in these areas are briefly reviewed. (JSR)

21200 (JINR-P-13-7098, pp 51-55) COAXIAL SILICON LITHIUM-DRIFTED DETECTORS. Afanas'ev, V. F.; Afanas'eva, N. P. (Inst. of Nuclear Physics, Leningrad). 1973. (In Russian).

From working conference on semiconductor detectors; Dubna, USSR (21 Jul 1972).

The use of coaxial geometry during the preparation of Si(Li) detectors expands the possibility of the use of semiconductor radiation detectors. The resolution of the detectors with a large working area is determined by the fluctuations of the charge loss during collection. This raises the problem of growing Si monocrystals of large volume with high values and degrees of homogeneity of the distribution of their original parameters. The preparation characteristics are described. The use of the coaxial geometry makes it possible to prepare Si(Li) detectors with a large sensitive volume for γ spectrometers insuring the formation of electron-positron pairs, coaxial detectors with a thin input window of large area for charged particle spectrometers, and miniature coaxial detectors for intracavity medical biological studies. (JSR)

21201 (JINR-P-13-7098, pp 56-66) ONE-DIMENSIONAL POSITION-SENSITIVE DETECTOR BASED ON p-i-n STRUCTURE. Voevoda, G. P.; Kibkalo, T. I.; Kurilo, P. M.; Litovchenko, P. G. 1973. (In Russian).

From working conference on semiconductor detectors; Dubna, USSR (21 Jul 1972).

The preparation of a one-dimensional position-sensitive p-i-n detector is described. Characteristics were measured at room temperature and at the temperature of liquid nitrogen. The values obtained for Pd and Nichrome position-sensitive films are tabulated. (JSR)

21202 (JINR-P-13-7098, pp 67-75) USE OF THE STRUCTURE OF DIELECTRIC-SEMICONDUCTOR FOR DETECTION OF NUCLEAR RADIATION. Barabash, L. I.; Gorban, A. P.; Litovchenko, V. G.; Litovchenko, P. G.; Chala, S. V. 1973. (In Russian).

From working conference on semiconductor detectors; Dubna, USSR (21 Jul 1972).

The use of the structure of a dielectric-semiconductor, prepared from very pure p-type Si, was proposed for the detection of nuclear radiation. The thermal oxidation of Si was carried out in an atmosphere of moist oxygen at a temperature of either 950° or 750°C. A schematic diagram is given of the detector. The volt-ampere characteristics were determined, and a typical α particle spectrum obtained with this detector is shown. (JSR)

21203 (JINR-P-13-7098, pp 76-91) METHOD FOR THE PREPARATION AND CHARACTERISTICS OF A SILICON SURFACE-BARRIER ΔE DETECTOR FOR RADIATION FROM NUCLEAR REACTIONS. Zorin, G. N.; Kushniruk, V. G.; Kharitonov, Yu. P. (Joint Inst. for Nuclear Research, Dubna, USSR). 1973. (In Russian).

From working conference on semiconductor detectors; Dubna, USSR (21 Jul 1972).

The method for the preparation of silicon surface barrier ΔE detectors is described. The steps include the preparation of plane-parallel Si foils by a mechanical process, purification of the foil surface from impurities, chemical etching with preservation of the plane-parallelism, measurement of the thickness of the foil, deposition of contacts on the foil surface, and construction of a mounting for the ΔE detector. The volt-ampere and volt-capacitance characteristics and the energy resolution of the ΔE detector were measured. (JSR)

21204 (KHFTI-72-45, pp 12-15) STUDY ON AIR ION LUMINESCENCE UNDER FAST ELECTRON EFFECT. Volovik, V. D.; Petrenko, V. V.; Popov, G. F.; Fursov, G. L. 1972. (In Russian).

A mechanism is proposed for the formation of the ionization luminescence under the influence of relativistic particles, according to which the luminescence originates because of slow secondary electrons. Experimental methods and equipment for the study of the problem of ionization luminescence of air are described. The results of the determination of the current and energy dependence of ionization luminescence are reported. It was assumed that the phenomenon studied can be used for the preparation of charged particle monitors. (tr-auth)

21205 (NRPB-R-18) MEASUREMENT OF ACTIVITY OF SURFACES CONTAMINATED BY ELECTRON-CAPTURE NUCLIDES. Iles, W. J.; White, D. F. (National Radiological Protection Board, Harwell (UK)). Apr 1974. 47p. Dep. NTIS (US Sales Only) $5.50.

The problems involved in the monitoring of surfaces contaminated by electron-capture nuclides and the interpretation of the results of measurements obtained with various types of detectors are reviewed. The electron-capture decay process and the general method for calculating the energies and abundances of the photons and electrons emitted by such nuclides are described and applied to the radiations emitted by the nuclides ^{51}Cr, ^{55}Fe, ^{57}Co, ^{109}Cd and ^{125}I in particular. The basic requirements of both gas-filled and scintillation detectors for monitoring for contamination by this type of nuclide are considered, together with the influence of the use of pulse height discrimination and collimation on their performance and the interpretation of measurements made with them. The response of a range of different types of detectors both to point and distributed sources of these nuclides have been measured and critically compared. Measurements have also been made with the source mounted inside a lead castle to compare the response of detectors when used for the measurement of "wipe-test" samples. The improvements in performance that may be obtainable by the use of selected detection and measurement techniques are discussed. (auth)

21206 (RISO-M-1724) PORTABLE CONTINUOUS SAMPLING INSTRUMENT FOR AIRBORNE BETA/GAMMA CONTAMINATION, INCORPORATING AN AUTOMATIC WARNING ALARM. Boetter-Jensen, L.; Griffin, S.; Soerensen, P. R. (Danish Atomic Energy Commission, Risoe. Research Establishment). Apr 1974. 9p. Dep. NTIS (US Sales Only) $4.00.

A portable air sampling instrument has been developed that simultaneously assesses any airborne particulate beta/gamma activity collected, and gives an alarm if a certain preset level is achieved. The development work was initiated because a need existed for some kind of a "watch dog" air sampler that could be used on routine work of a low risk nature, and which would give an audible alarm if airborne contamination arose. In practice alarms have been received at concentrations low enough to ensure that operators to date have received no measurable internal contamination. The instrument design, method of operation, testing procedures, and results are described. (auth)

21207 (SSI-1973-022) TESTING OF ISOTOPE CALIBRATION INSTRUMENTS. Lundehn, I. (Statens Straalskyddsinstitut, Stockholm (Sweden)). Oct 1973. 39p. (In Swedish). Dep. NTIS (U. S. Sales Only) $5.00.

A committee has been set up by the Swedish association for radio-physics in order to introduce unified rules for the measurement of radionuclides. One of its tasks was to check the accuracy of isotope calibration instruments. This is of importance in view of the increasing use of radioisotopes in hospitals for diagnosis and therapy and also from the point of view of the isotope supplier. Nine isotope calibration instruments from various sources (U.S.A., Holland, Israel, England, Sweden and Germany), were tested under strictly-controlled conditions using the following radionuclides: ^{125}I, ^{57}Co, ^{99m}Tc, ^{131}I, ^{85}Sr, ^{137}Cs, ^{59}Fe and ^{60}Co. The radionuclides were obtained from AB Atomenergi, Studsvik, Sweden. In addition specially-calibrated ^{125}I was obtained from the Radiochemical Center, Amersham, England and ^{57}Co, ^{60}Co and ^{137}Cs from New England Nuclear, U.S.A. The nine calibration instruments were each designated by a code letter. All nine instruments showed a large deviation from the calibrated value for ^{125}I which is explained by the difficulty of measuring at this low energy level. One of the instruments was badly calibrated within the energy range considered, i.e., 35 keV to 1.25 MeV. Activity-dependence was investigated in the range 2 μCi to 550 mCi. One instrument was clearly activity-dependent, two were weakly activity-dependent, but the rest were activity-independent. Error due to incorrect placing of the isotope flask was 3.5%. Maximum stability was investigated over a period of 20 hours; no instability was observed. All the instruments were independent of supply voltage between 200 and 245 V. Three instruments were slightly dependent on the volume of the isotope flask. Two instruments had correction for temperature and pressure. The effect of the lead (Pb) shield was also observed. The complete investigation showed that no instrument was absolutely perfectly calibrated. (SW)

21208 SENSITOMETRIC EVALUATION OF SOME ELECTRONOGRAPHIC EMULSIONS FOR BEAM ENERGIES IN THE RANGE 5 TO 35 kV. Jeffers, S. (York Univ., Toronto); McGee, J. D. pp 27-30 of Optical Instrumentation Engineering in Science, Technology, and Society. Katz, Y. H. (ed.). Redondo Beach, CA; Society of Photo-Optical Instrumentation Engineers (1973).

From proceedings of the Society of Photo-Optical Instrumentation Engineers; San Mateo, California, USA (16 Oct 1972). See CONF-721032-.

The absolute sensitivity of L4, G5, and XM Ilford emulsions to electrons from 5 to 35 keV was measured, and the results are presented. (WHK)

21209 AN IMPROVED HIGH-LEVEL WHOLE-BODY COUNTER. Hodges, H. D.; Gibbs, W. D.; Morris, A. C. Jr.; Coffey, W. C. II. (Oak Ridge Associated Universities, TN). J. Nucl. Med.; 15: No. 7, 610-612(Jul 1974).

A whole-body counter is described that is relatively inexpensive to build and provides quantitative whole-body radioisotope retention values from 0.01 to 100 mCi. Two NaI(Tl) detectors suspended from the ceiling are positioned so that a point source anywhere on the bed gives a uniform counting response (±5%). Subjects are counted on a floor-level pad 1.9 meters under the detectors. The pad is hinged and can be fastened flat against the wall of the counting room when not in service. Optimum-window counting techniques provide a highly quantitative response regardless of the distribution of activity within the subject. A 1-min count of a person with more than 0.1 mCi results in an expected standard deviation of less than ±5%; 10 min are required for similar statistical results in the 0.01 to 0.1 mCi range. (auth)

21210 RADIONUCLIDE DEVICE WITH AUTOMATIC COMPENSATION OF RADIONUCLIDE DECAY EFFECT. Seda, J.; Musilek, L. Czech Patent 146,449. 15 Dec 1972. Filed date 7 Dec 1971. 2p.

The device described consists of a single detector whose output is interconnected to the analyzer input. In the analyzer, the differential energy spectrum is separated into two signals by means of discrimination levels. The first signal carries information on the quantity measured and the second is independent of the quantity measured. The two analyzer outputs are connected to the inputs of a dividing circuit. The resulting ratio of the two signals is independent of a decrease in the radionuclide activity. The dividing circuit output is connected to the input of the terminal circuit in which the signal is indicated, recorded or otherwise evaluated. (Nuclear Sci. Abstr. Czeck.)

21211 EVALUATION OF THE TIMING PULSES OF Si(Li) DETECTOR. Okada, E. (Himeji Inst. of Tech., Japan); Ochiati, F.; Fukuda, M. Himeji Kogyo Daigaku Kenkyu Hokoku; No. 26A, 1-8 (Oct 1973). (In Japanese).

The output currents from a Si(Li) detector, its depletion layer and capacitance being 1 mm and 5 pf, were calculated for 300 and 500 keV β rays. The timing pulses were calculated at incident angles of 0, 10, and 20°, when the time-pick-off transformer is connected (case A) in series to the detector and (case B) after the FET. The time walk and noise jitter are estimated for the L.E.T. method at the input of the time-pick-off circuit. The trigger level of the pick-off circuit at its input is assumed to be three fourths of the pulse height of 300 keV (250 mV · ps) in (case A), and in (case B), (1) 12% (250 mV · ps), (2) 17% (450 mV · ps), and (3) 21% (640 mV · ps). The time walk for 300 keV increases slightly with the increase of the angle. On the contrary the time walk for 500 keV is all negative and its absolute value increases with the incident angle owing to energy loss and the longer range which is almost equal to the depth of the depletion layer. In all cases, the time walk caused by the incidence angle is less than 10 ps. The jitter caused by FET noise (2.8 μV equivalent input) is less than 20 ps in all cases. The walk and jitter in the timing system of β rays with cooled Si(Li) is dominantly caused by the discriminator. (auth)

21212 OPTIMIZATION OF INFORMATION-MEASUREMENT CIRCUIT OF RADIATION MONITORING SYSTEMS. Klimov, A. N.; Matveev, V. V.; Makhnovskii, I. V.; Nemirovskii, B. V. At. Energ. (USSR); 35: No. 5, 333-337(Nov 1973). (In Russian).

An approach to the design of multichannel systems for radiation monitoring from the standpoint of simplified algorithms of processing input information flow is considered. Mathematical expressions for input and output information flow are presented and analyzed. One possible system is described and the main conclusions summarized. (auth)

21213 NEUTRON AND GAMMA-RAY EFFECTS ON SELF-POWERED IN-CORE RADIATION DETECTORS. Warren, H. D.; Shah, N. H. (Babcock and Wilcox Co., Lynchburg, VA). Nucl. Sci. Eng.; 54: No. 4, 395-415(Aug 1974).

A general calculational model describing the effects of neutrons and gamma rays on self-powered prompt-responding coaxial in-core radiation detectors is presented. The model accounts for external gamma-ray interactions within a detector and the subsequent emissions of Compton electrons and photoelectrons. The model also includes neutron-capture gamma-ray and internal-conversion electron emissions. The effect on a detector's sensitivity of space charge within its insulator is considered. A pseudopotential on the central electrode is introduced to account for Z-dependent variations in the space-charge distribution. Calculated neutron and gamma sensitivities of several in-core detectors are compared with experimental sensitivities. The comparisons are sufficiently satisfactory to label the model as successful in its predictions. (auth)

21214 THEORY OF THE VARIATION OF MEAN GAP LENGTH WITH CHARGE IN NUCLEAR EMULSIONS. Sharma, A. P.; Sharma, G. P. (Kurukshetra Univ., India). Indian J. Pure Appl. Phys.; 12: No. 1, 13-16(Jan 1974).

A new theoretical model for evaluating the effective number of electrons responsible for the photographic process and the mean gap length is proposed. The model takes into account the ionic processes, their capture cross-sections, thermal velocities of the carriers, etc. The dependence of the mean gap length on the charge (Z), velocity (β) of the ionizing particle and the exposure temperature (T) is computed. The theoretical results are found to agree well with the experimental data. (auth)

21215 GEYSER, A NEW DETECTOR FOR NUCLEAR RECOILS. Hahn, B.; Reist, H. W. (Univ., Bern). pp 432-435 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973). See CONF-730642-.

A new method of extreme simplicity for detecting heavily ionizing particles, e.g., nuclear recoils, has been found. A suitable liquid of large volume, containing a desired dissolved material is superheated. For a given ionizing power of a particle there is a sharp threshold sensitivity. The detector is for low level counting and is continuously sensitive. (auth)

21216 LARGE MULTIWIRE SPARK COUNTER. Usacev, S.; Oravec, J.; Holy, K. (Komenskeho Univ., Bratislava). Acta Fac. Rerum Natur. Univ. Comenianae, Phys.; 14: 113-126(1973). (In Slovak).

A large multiwire corona-spark counter is described. The filling and purification system and the counting system are shown. Some parameters of the counters in terms of using them for low-level alpha activity measurement were measured and are discussed. (auth)

Radiation Dosimeters

Refer also to abstracts 22977 and 22978.

21217 (FRNC-TH-474) STUDY AND DEVELOPMENT OF TWO IONIZATION CHAMBERS FOR THE DOSIMETRY OF SMALL ^{252}Cf SOURCES. Biau, A. (Toulouse-3 Univ., 31 (France)). 1973. 82p. (In French). Dep. NTIS (US Sales Only) $7.25.

Thesis.

Two multiplication chambers were developed and constructed for separately measuring the neutron and γ radiation doses from radiotherapeutically (interstitial and intracavity) used ^{252}Cf sources. Measurements were made of the dose rate around a point source of ^{252}Cf (20 μg) located in a phantom filled with a liquid having an equivalent atomic composition to biological tissue. The measurements made were reproducible within 5% for dose rates ranging from 1 to 300 rads/hour. The results obtained are used in a program which permits isodose curves to be determined around a source having any given geometry. (FR)

21218 (HASL-285) $CaSO_4$:Dy TLD FOR LOW LEVEL PERSONNEL MONITORING. Shambon, A. (USAEC Health and Safety Lab., New York). Jun 1974. 15p. Dep. NTIS $4.00.

The use of $CaSO_4$:Dy powder packed in polyethylene capsules for environmental radiation dosimetry was investigated. The preparation of the powder thermoluminescence dosimeter is described and the results from monthly test exposures for a year are compared with simultaneous LiF measurements at the same indoor and outdoor locations. A comparison is made with results obtained with the glass-enclosed CaF_2:Mn dosimeter. (auth)

21219 (IEA-322) PREPARATION OF THERMOLUMINESCENT CALCIUM SULFATE ACTIVATED WITH THULIUM DISPERSIONS. Guenin, M.; Campana, M. M. P. (Instituto de Energia Atomica, Sao Paulo (Brazil)). Jan 1974. 8p. (In Portuguese). Dep. NTIS (US Sales Only) $4.00.

Dosimetry grade $CaSO_4$ doped with Dy or Tm was prepared using calcium sulfate and sulfuric acid to which an appropriate amount of Dy_2O_3 or $Tm_2(SO_4)_3$ was added. Vibrations during evaporation preclude formation of grains larger than 10 microns. A still evaporation produced crystals about 1 mm in diameter. The thermoluminescence of calcium sulfate thus prepared was examined. Its sensitivity is comparable to that made by Harshaw Chemical Co. (auth)

21220 (SLAC-Trans-164) DISPERSED DETECTOR OF AN INDIVIDUAL THERMOLUMINESCENT NEUTRON DOSIMETER. Kazanskaya, V. A.; Kuz'min, V. V.; Makarov, Ya. A.; Minaeva, E. E.; Rynkov, G. I.; Sokolov, A. D. Translated from Yadern. Priborostr.; No. 13, 118-122(1970). 8p. Dep. NTIS $4.00.

A dosimetric detector with the thermophosphor dispersed in a thermostable hydrogen-containing material is described. The principal parameters of the detector, the dependence of the sensitivity on phosphor concentration, the dose dependence, the statistical variance of the sensitivity, and the hardness dependence with respect to γ radiation and neutrons are described. The optimal volume concentration of the phosphor is 300 mg/cm^3, at which the statistical variance of the detector sensitivity is ±7.4%. The detectors have a linear dose characteristic between 50 mrem and 5 krem. The detector sensitivity to 1 rem neutron equivalent dose is practically constant in the energy range from 50 keV to 4.5 MeV. A lead filter (0.64 mm) compensates the hardness dependence within the limits of ±20% for 100 keV-1.25 MeV γ radiation. (auth)

21221 EVALUATION OF DATA FROM CONDENSER IONIZATION CHAMBERS. Fronka, O.; Krizek, V.; Landovsky, J.; Plestil, Z.; Vit, V.; Pavlicek, Z.; Moucka, L.; Cernavsky, J. Czech Patent 146,510. 15 Dec 1972. Filed date 21 Jan 1972. 2p.

A contactless transmission of the signal from condenser ionization chambers to an evaluation device placed outside the hermetically sealed space of the dosemeter is proposed. This represents a way of evaluating data obtained by condenser ionization chambers. The charge of the dosemeter condenser affects inductively the measuring gage via the coupling capacitor, thus changing the capacity of either the dosemeter or the coupling capacitor. The resulting change is dependent on the charge of the dosemeter condenser. (Nuclear Sci. Abstr. Czech.)

21222 POLUPROVODNIKOVYE DETEKTORY V DOSIMETRII IONIZIRUIUSHCHIKH IZLUCHENII. (Semiconductor Detectors in the Dosimetry of Ionizing Radiation). Krongauz, A. N.; Liapidevskii, V. K.; Mandel'tsvaig, Yu. B.; Podgornyi, V. N. Moscow; Atomizdat (1973). 180p.

The physical processes which occur in the sensitive volume of an irradiated semiconductor detector and which define the detector output-signal characteristics are examined. The influence of external factors on the detector characteristics is studied. The design and characteristics of homogeneous and inhomogeneous semiconductor detectors are described, and the techniques used in the application of such detectors to the measurement of ionizing radiation doses are outlined. (IAA)

21223 CHARGING OF RADIOACTIVE RADIATION DOSEMETER. Fronka, O.; Moucka, L.; Pavlicek, Z.; Cernavsky, J. Czech Patent 145,736. 15 Oct 1972. Filed date 7 Dec 1971. 2p.

A method for charging a dosemeter operating on the principal of discharging a capacitor, i.e., of charging the capacitor of the dosemeter to operating potential is described. Mechanical movement of a friction segment against the electrode of the charging capacitor or against a surface connected to it results in the charging of the capacitor electrode. The charged capacitor is then connected to the inner electrode of the dosemeter capacitor. The connection only lasts until the capacitor of the dosemeter is charged to operating potential. (Nuclear Sci. Abstr. Czech.)

21224 COMPARISONS OF THE CHARACTERISTICS OF TLD (Mg_2SiO_4) PERSONAL MONITOR, FILM BADGE AND POCKET CHAMBER. Watanbe, Y.; Okumura, H.; Sugie, Y.; Hayakawa, N.; Narita, H. (Nagoya Univ., Japan). Nippon Hoshasen Gijutsu Gakkai Zasshi; 29: No. 3, 271-277(Sep 1973). (In Japanese).

The characteristics of personnel monitors (thermoluminescence dosimeter (Mg_2SiO_4), film badge and pocket chamber) were examined. TLD personnel monitors showed no fading and considerable background in low exposures. Three personnel monitors showed energy dependence; the film badge showed less energy dependence than the TLD personnel monitor in the low energy range and the pocket chamber had a high sensitivity in the low energy range. TLD personnel monitors showed a dose dependence in the low dose range, but film badges and pocket chambers did not show a dose dependence. TLD personnel monitors were better than the

film badges and pocket chambers because it was possible to measure low exposures of under 10 mR and high exposures of over 1 R. (auth)

21225 MEASUREMENT OF ABSORBED DOSE AND FLUX IN A REACTOR BY CHEMICAL DOSIMETRY. Moriyama, N.; Ikezoe, Y.; Sato, S.; Danno, A. (Japan Atomic Energy Research Inst., Tokai). J. Nucl. Sci. Technol. (Tokyo); 11: No. 4, 141-145(Apr 1974).

Nitrous oxide, carbon dioxide, and ethylene were utilized as gaseous chemical dosimeters, and measurements were made of the doses absorbed by these substances in a nuclear reactor. The neutron and photon fluxes as well as their contributions to the absorbed doses were determined by analyzing the data obtained from the chemical dosimetry, with particular consideration given to the fast neutron energy spectrum. The values of the photon, thermal neutron, and fast neutron fluxes thus determined were 2.6×10^{13} $\gamma/cm^2 \cdot sec$, 3.5×10^{13} $n/cm^2 \cdot sec$ and 7.0×10^{12} $\exp(-E) \sinh \sqrt{2E}$ $n/cm^2 \cdot sec$. These values were compared with the results from calorimetric activation methods, and were found to be in fair agreement. From the results, it was confirmed that the combination of chemical dosimeters are servicable for the measurement of both absorbed dose and fluxes in a nuclear reactor. (auth)

21226 PORTABLE DEVICE FOR SIGNALLING EXCESSIVE DOSES OF IONIZING RADIATION. Chojnacki, W. Czech Patent 147,332. 24 Mar 1972. 5p. (In Czech).

An improved pocket-size device for signalling excessive doses of ionizing radiation is proposed. One of the advantages of the device is the fact that its electrical system is equipped with a means for pre-setting the dose limit of ionizing radiation and the beginning of indication is easily detectable. The control system consists of a single pushbutton for the control of the power supply voltage, of the correct function of the electrical system and of the charging of the ionization chamber capacitor. The ionization chamber is in the shape of a prism one side of which is rounded. The inside of the ionization chamber is partitioned up to three quarters of its height and in the cavities thus formed, a trough connector is placed at an even distance to the chamber walls. At a low supply voltage the ionization chamber of the said shape has linear characteristics over a wide range of ionizing radiation intensity. The functioning of the indication device is independent of weather conditions. (INIS)

21227 FAST NEUTRON DOSEMETER. Spurny, Z. Czech Patent 147,342. 24 Mar 1972. 3p. (In Czech).

A design is proposed for a fast neutron dosemeter (for energy ranges greater than 0.1 MeV) suitable mainly as a personnel dosemeter. The dosemeter consists of a case made of an activation or a threshold dosemeter in the cavity of which an exoemission solid-state detection dosemeter is placed. A suitable combination of two design elements, one made of a solid-state detector, e.g., a thermoluminescent detector, and another made by a modification of an activation dosemeter or a threshold dosemeter, resulted in a relatively small-sized dosemeter of fast neutrons, sensitive to small amounts of radiation. (INIS)

Nuclear Spectroscopic Instrumentation

Refer also to abstract 21937.

21228 (AED-CONF-74-042-005) Ge(Li)-SEMICONDUCTOR DETECTORS FOR THE SPECTROMETRY OF HIGH-ENERGY CHARGED PARTICLES IN THE ENERGY RANGE OF THE JUELICH CYCLOTRON. Protic, D.; Riepe, G. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Festkoerperforschung; Karlsruhe Univ. (TH) (F. R. Germany)). 1974. 5p. (In German). INIS.

From spring meeting of the working group on nuclear and high-energy physics of the Deutsche Physikalische Gesellschaft eV.; Juelich, Germany (4 Mar 1974).

The development and testing of Ge(Li) detectors for charged particle spectrometry at the Juelich cyclotron are described. Depletion layers were reduced to 1 μm and the energy resolution was 40 keV for 77 MeV deuterons and 18.6 keV for 45 MeV protons. (INIS)

21229 (JAERI-M-5466) CHARACTERISTICS OF THE PROTON-RECOIL PROPORTIONAL COUNTERS WITH FIELD TUBES. Obu, M.; Ichimori, T.; Shirakata, K. (Japan Atomic Energy Research Inst., Tokyo). Dec 1973. 15p. (In Japanese). INIS.

The proportional counters used for a proton-recoil spectrometer and improvements made on the field tubes are described. The configuration of the electrodes is simplified by using a ceramic cylinder with a metal layer, instead of the ordinary metallic tubes. The resolution of the counters is very high and is shown to be 3.9% at the gas multiplication of 17.6 for the hydrogen filling gas. From the responses of counters to monoenergetic neutrons, the saturation in gas multiplication is found to occur at about 2×10^5 ion pairs at the collecting electrode. In the hypodermic-needle field-tubes, events due to primary ionizations are caused; thus the hypodermic-needle type is not suitable in low gas multiplications. (INIS)

21230 (JINR-D13-7616, pp 23-27) TWO-DIMENSIONAL ANALYZER WITH DIGITAL WINDOWS ON-LINE WITH THE SMALL COMPUTER TRA-1001. Nefed'ev, O. K.; Shul'tse, V. (Joint Inst. for Nuclear Research, Dubna, USSR). 1974. (In Russian).

From 7th international symposium on nuclear electronics; Budapest, Hungary (17 Sep 1973).

For study of $\gamma-\gamma$ coincidences and time-amplitude measurements made on the heavy particle beam of the U-300 cyclotron, a high-energy resolution of the γ spectra measured with a Ge detector is required during high density of events. A block diagram of the measurement apparatus is given. Time resolutions better than 20 nsec are obtained for all γ spectra with energy greater than 50 keV. A block diagram is also given of the recording installation, and a block diagram of the interface of the two-dimensional analyzer with the TRA-1001 computer is shown. A typical two-dimensional spectrum of the $\gamma-\gamma$ coincidences during the radioactive decay of ^{169}Yb is given as an illustration. (JSR)

21231 (JINR-D13-7616, pp 75-82) CAMAC SYSTEM FOR CONTROL OF NEUTRON SPECTROMETER. Lazarkiewicz, L.; Michalski, M.; Starzynski, A. (Inst. of Nuclear Research, Swierk, Poland). 1974.

From 7th international symposium on nuclear electronics; Budapest, Hungary (17 Sep 1973).

A block diagram of the control system is given, and the operation of the system is described. The neutron spectrometer is located at a research reactor at the University of Nuclear Research in Swierk. (WHK)

21232 (JINR-D13-7616, pp 99-104) YUPITER-16: PROGRAM FOR THE ACQUISITION AND PROCESSING OF PHYSICAL DATA WITH THE ACTIVE INTERACTION OF THE EXPERIMENTER AND COMPUTER. Lang, I. (Joint Inst. for Nuclear Research, Dubna, USSR). 1974. (In Russian).

From 7th international symposium on nuclear electronics; Budapest, Hungary (17 Sep 1973).

The interaction program YUPITER-16 was developed for the storage and processing of spectra obtained during work with different measurement systems. The input of experimental data into the minicomputer for processing can be done directly with a coder and different spectrometers, with external analyzers, and with punched tape or manually. The characteristics of the interactive system are outlined. The control system is also given. The energy calibration of the spectra, the smoothing process, and spectral normalization are briefly described. (JSR)

21233 (JINR-D13-7616, pp 224-237) SIRIUS: A PROGRAM PACKAGE FOR NUCLEAR DATA PROCESSING. Horvath, D.; Kulcsar, K.; Nagy, D. L.; Pocs, L. (Central Research Inst. for Physics, Budapest). 1974.

From 7th international symposium on nuclear electronics; Budapest, Hungary (17 Sep 1973).

SIRIUS is an Algol 60 package for the ICL 1905 of the Central Research Institute, Budapest, for handling and evaluation of nuclear gamma, Moessbauer, and lifetime (including positron lifetime) spectra. The program is described, and some applications are discussed. (WHK)

21234 (JINR-D13-7616, pp 295-298) INPUT INSTALLATION IN THE CAMAC FOR MULTIDIMENSIONAL MEASUREMENTS. Barabash, I. P.; Borgzel, A. A.; Elizarov, O. I.; Ishmukhametov, M. Z.; Solov'ev, B. I.; Tishin, V. G.; Khoang Zyong Kuan; Shibaev, V. D. (Joint Inst. for Nuclear Research, Dubna, USSR). 1974. (In Russian).

From 7th international symposium on nuclear electronics; Budapest, Hungary (17 Sep 1973).

Input installations used in multidimensional spectrometric installations, designed for studying the properties of protons and particles, consist of two identical amplitude coders, coding of the transducer number, and a specialized controller organizing the operation of the units in the desired experimental regime and having internal memory for command and external amplifiers for connection with the storage installation of the analyzer. This type of system designed for use at JINR is described in detail and its technical characteristics are given. (JSR)

21235 (JINR-D13-7616, pp 299-304) ANALOG-TO-DIGITAL CONVERTERS IN CAMAC SYSTEM. Kulka, Z.; Bayer, R.; Koba, T. (Inst. of Nuclear Research, Swierk, Poland). 1974.

From 7th international symposium on nuclear electronics; Budapest, Hungary (17 Sep 1973).

Three analog-to-digital converters developed at the Institute of Nuclear Research in Swierk are described. Two of the ADC's are 4096-channel converters for high-resolution applications in nuclear spectroscopy. The 512-channel converter described was designed for single or multiparameter nuclear physics experiments. (WHK)

21236 (JINR-D13-7616, pp 358-364) ORGANIZATION OF THE ACQUISITION OF SPECTROMETRIC DATA USING A SMALL COMPUTER WITH EXTERNAL FAST MEMORY. Vagov, V. A.; Zamrii, V. N.; Salai, Sh. (Joint Inst. for Nuclear Research, Dubna, USSR). 1974. (In Russian).

From 7th international symposium on nuclear electronics; Budapest, Hungary (17 Sep 1973).

A block diagram is given of the system for the acquisition of spectrometric data using a small computer of the TRA 1001 type and external fast memory. The flow of the data from acquisition from a pulsed neutron detector to its storage is described. (JSR)

21237 (JINR-P-13-7098, pp 92-100) SPECTROMETRIC TRANSDUCER FOR X-RADIATION BASED ON A RADIATION SEMICONDUCTOR DETECTOR. Gershman, V. S.; Golubev, Yu. A.; Danengirsh, S. G.; Pakhomov, E. E.; Polytsya, O. P.; Federova, S. F.; Shchekin, K. I. 1973. (In Russian).

From working conference on semiconductor detectors; Dubna, USSR (21 Jul 1972).

A cooled primary cascade of a preamplifier with field transistors was used for realization of high energy resolution. The construction of the primary block of the transducer and its principal electrical circuit are shown. The noise parameters of the field transistors KP303G at room temperature are tabulated. The noise and frequency characteristics of the commercial high-ohm resistors were also determined and the value tabulated. Typical x-ray spectra obtained are shown. (JSR)

21238 (MPI-H-1973-V34) CAMAC STUDY: PROCESS COMPUTER FOR A MAGNETIC BETA-SPECTROMETER. Wiemers, M.; Dehnhardt, W.; Nouvel, P.; Martin, B. (Max-Planck-Institut fuer Kernphysik, Heidelberg (F. R. Germany)). 1974. 90p. (In German). (AED-Conf-74-042-016). INIS.

From spring meeting of the Deutsche Physikalische Gesellschaft e.V. of the working group "nuclear and high-energy physics"; Bochum, Ger. (4 Mar 1974).

The Heidelberg beta-spectrometer has been connected to the CAMAC system and on-line-operation has been started. As a first application, the relative intensities of conversion electrons of ^{152}Sm of the K, L and M-shells have been determined. Excellent agreement has been obtained with theoretical values from a relativistic Hartree-Fock-Slater model. (INIS)

21239 (RT/EL-(73)5) NOISE REDUCTION IN CHARGE PREAMPLIFIERS BY ELIMINATION OF SHUNT FEEDBACK RESISTOR. Barlocci, A.; Colante, D. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 27 Nov 1973. 20p. Dep. NTIS $4.00.

Two methods for reducing the contribution to preamplifier electronic noise in semiconductor x-ray spectrometers due to shunt feedback resistor are described. The feedback resistor removal can be obtained in a very simple way controlling the feedback capacitor charge level by the drain leakage current of the input FET. A practical circuit of a charge preamplifier, based on the described principle, is given and the first experimental results are presented. (auth)

21240 VERSATILE DATA PROCESSING SYSTEM FOR NUCLEAR GAMMA-RAY SPECTROSCOPY WITH A MINICOMPUTER. Matsuki, S.; Marubayashi, K. (Kyushi Univ., Fukuoka). Jap. J. Appl. Phys.; 13: No. 4, 697-705(Apr 1974).

A versatile data-processing system using a mini-computer USC-3 has been developed for nuclear gamma-ray spectroscopy with Ge(Li) detectors. In order to perform data analyses in a conversation mode more easily and rapidly a light-pen system was constructed and connected to the USC-3 computer. The light-pen system made with a photodiode and TTL digital IC's was designed so as to be applicable to any computer-aided pulse-height analysis system. The gamma-ray spectrum data were analyzed with the aid of the light-pen system and software programs in the assembler language. The spectrum analysis programs mainly consist of the smoothing of the original data, the automatic search for peaks in the spectrum and the evaluation of the peak positions and areas after background subtraction. The design principle and the circuits of the light-pen system and softwares for spectrum analyses are described. (auth)

21241 ALPHA SPECTROSCOPY WITH A GRID IONIZATION CHAMBER. Voelkle, H.; Ribordy, L.; Halter, J.; Huber, O.; Winiger, P. (Univ., Frieiburg i. B.). Helv. Phys. Acta; 47: 97-105(1974). (In German).

A measuring system with a grid ionization chamber for detection of α-emitting nuclides in environmental samples is described. By optimal design of chamber and associated electronics a good resolution of 35.5 keV fwhm for a ^{210}Po electrodeposited source, with very low background (7.2 counts/h in the interval from 4 to 6 MeV) was achieved. This allows one to determine ^{239}Pu activities of a few pCi/g mineralized substance. For measuring the α-spectrum, 20 to 30 mg of a mineralized sample material is deposited on the source-holder by evaporation of an adequate solvent. If necessary, Pu or U are chemically separated from the solution (with TIOA or TTA) and measured separately. (auth)

21242 SIMULATION OF THE LOGICAL SEQUENCE IN NEUTRON SPECTROMETER CONTROL PROGRAMS. Blanchard, P.; Ledebt, P.; Taeschner, M. (Institut Laue-Langevin, Grenoble, France). pp 91-95 of Computing with Real-Time Systems. Vol. 2. Pyle, I. C. (ed.). London; Transcripta Books ([nd]).

From second European seminar on real-time systems; Erlangen, Germany (Apr 1972).

The system, which is described, uses the IBM 360/67 of the Institute of Applied Mathematics of the University of Grenoble. The programming language used is FORTRAN. Information transfer between experiments and computer is through the CAMAC system. The subject is dealt with under the following headings: generalities and introduction; description of the System Carine; simulation; the system CP/CMS = Cambridge Monitor System); and the system SIMUL and libraries. (UK)

21243 MONITORING OF COOLANT ACTIVITY IN WATER-COOLED POWER REACTORS BY IN-LINE γ-SPECTROMETRY WITH COMPUTER EVALUATION. Budnick, G. (Siemens A. G., Erlangen (F. R. Germany). Unternehmensbereich Energietechnik); Neeb, K. H. (Kraftwerk Union A. G., Erlangen (F. R. Germany). Reaktortechnik). At. Strom; 20: No. 3; 4, 32-36(Mar 1974). (In German).

From reactor meeting; Karlsruhe, F. R. Germany (10 Apr 1973). 5 figs.; 9 refs.

The paper reports on development work aimed at reducing the effort involved in radiochemical coolant monitoring while maintaining the information content. Practically all important fission product nuclides can be detected without interference and with no sampling by γ-spectrometric activity measurement using a high-resolution Ge(Li) detector on a line through which a coolant is flowing (so-called in-line γ-spectrometry). A computer program for evaluating the γ-spectra obtained is described, which is suitable for process computers and guarantees good accuracy and reliability of the results. (auth)

21244 ACCURACY OF EXTERNAL STANDARDIZATION SYSTEMS IN TWO COMMERCIALLY AVAILABLE SPECTROMETERS USING GAMMA SOURCES OF HIGH OR LOW ENERGY. Gogan, F.; Gogan, P. (Unite de Recherches Neurobiologiques, Marseille). Anal. Biochem.; 60: No. 2, 363-371(Aug 1974).

The use of a high-energy source (^{226}Ra) instead of a low one (^{137}Cs) for external standardization in liquid scintillation counting appears to give more constant and accurate results when changing sample parameters like quenching, volume, isotopic activity, and vial material. The most important effect is a large decrease, over many hours, of the counting efficiency computed by external standardization, when using polyethylene vials and the ^{137}Cs source. No changes were observed when using a ^{226}Ra source. (auth)

21245 MULTIDIMENSIONAL GAMMA RAY SPECTROMETRY AND ITS APPLICATIONS IN LOW RADIOACTIVITY PHYSICS. I. Analysis of Spectrometric Methods and Spectrometer Design. Usacev, S.; Povinec, P.; Chudy, M. Acta Fac. Rerum Natur. Univ. Comenianae, Phys.; 14: 79-104(1973). (In Slovak).

The analysis of spectrometric methods of low-level gamma counting using anticoincidence and coincidence systems of registration is presented. The high sensitive multidimensional gamma-gamma spectrometers are described which enable to reach the minimum measurable activity of the order of 10^{-13} Ci. (auth)

High Energy Physics Instrumentation

Refer also to abstracts 21938, 21979, and 22300.

21246 (JINR-D13-7616, pp 40-51) RECENT DEVELOPMENTS IN NUCLEAR DIGITAL SYSTEMS AT DARESBURY. Zacharov, B. (Daresbury Nuclear Physics Lab., Eng.). 1974.

From 7th international symposium on nuclear electronics; Budapest, Hungary (17 Sep 1973).

Work at Daresbury on multiwire proportional chamber systems is outlined. A new readout system and magnetic tape storage system for multiwire proportional chambers are described. (WHK)

21247 (JINR-D13-7616, pp 217-220) READOUT ELECTRONICS FOR DRIFT CHAMBERS. Turala, M. (Inst. of Nuclear Physics, Krakow). 1974.

From 7th international symposium on nuclear electronics; Budapest, Hungary (17 Sep 1973).

Some general remarks on readout electronics for drift chambers are presented. The logic of selected design and the parameters of a single measuring channel are shown. (auth)

21248 (LA-5648-MS) AN IDENTIFYING, MOMENTUM-SENSITIVE DETECTOR SYSTEM FOR NEGATIVE PIONS. Meyer, H. O.; Springer, K. (Los Alamos Scientific Lab., N. Mex. (USA)). Jul 1974. Contract W-7405-eng-36. 4p. Dep. NTIS $4.00.

A detector arrangement for identifying negative pions by detecting star events is described. Decay protons from a star event are detected on coincidence with the incident stopped π^-. The detector consists of a stack of thin scintillator sheets. The initial pion momentum can be determined from a range measurement. The described system compares favorably with devices described earlier with respect to its high efficiency and its geometrical uniformity. Preliminary data have been taken which demonstrate the usefulness of the system. (WHK)

21249 PROGRESS OF THE VIENNA SPIRAL READER PROJECT. Katz, P. A. pp 62-89 of Proceedings of the Triangle Seminar. Haberler, P. L. F. (ed.). Vienna; Institut fuer Hochenergiephysik, Oesterreichische Akademie der Wissenschaften (1972).

From Triangle seminar on experimental high energy physics; Vienna, Austria (9 Oct 1972). See CONF-7210121-.

The layout, operation, and performance of the spiral reader for digitizing particle tracks on bubble chamber film are described. (WHK)

21250 WORK OF THE 300 GeV PARTICLE IDENTIFICATION GROUP OF ECFA (2ND TIRRENIA STUDY WEEK, SEPT. 1972). CERN-Trieste High-Energy Group. pp 146-164 of Proceedings of the Triangle Seminar. Haberler, P. L. F. (ed.). Vienna; Institut fuer Hochenergiephysik, Oesterreichische Akademie der Wissenschaften (1972).

From Triangle seminar on experimental high energy physics; Vienna, Austria (9 Oct 1972). See CONF-7210121-.

Research by the ECFA on transition radiation detectors for the ultra-relativistic region, Cherenkov counters, and spectrometers for low energy particles is discussed. (WHK)

21251 INTERFERENCE REMOVER CIRCUIT TO REJECT PULSES DUE TO CLOSELY FOLLOWING PARTICLES IN NUCLEAR INTERACTION. Upadhyay, P. N. (Gaya Coll., India). Indian J. Pure Appl. Phys.; 11: No. 11, 859-860(Nov 1973).

Details and operation of a fast electronic circuit designed to inspect and reject pulses caused in the detector system by two or three beam particles coming closely following each other, are reported. The circuit designated as "interference remover" reduces considerably the accidents in a missing mass counter experiment, provided two or more particles do not come within the dead-time (10 nsec) of the discriminator. (auth)

21252 DRIFT CHAMBER: A PARTICLE DETECTOR OF HIGH POSITION AND TIME RESOLUTION. Walenta, A. H. (Univ., Heidelberg). pp 171-189 of Physik 1973. Weinheim, Ger.; Physik Verlag GmnH (1973). (In German).

From 37th physicists conference; Hamburg, F. R. Germany (24 Sep 1973). See CONF-730993-.

It was shown that it is possible by measurement of the electron drift time in a large-surface proportional chamber to measure the position and time points of particle passages with high accuracy. The results in an experiment at the CERN proton synchrotron, which contains a magnetic spectrometer supplied with drift chambers, showed that these chambers operate for a long time without failure in a high radiation field and that they are comparable with other particle detectors. (tr-auth)

21253 RESPONSE FUNCTIONS OF COSMIC RAY MUON TELESCOPES AT SEA LEVEL AND 60 m.w.e. Hicks, R. B.; Simpson, G.; Mathews, T. (Univ. of Calgary, Alberta). Can. J. Phys.; 52: No. 11, 979-984(1 Jun 1974).

A theoretical determination of the primary response of cosmic ray muon telescopes is presented. The calculations take into account successive collisions of an incoming primary nucleon, the distribution in energy of pions and muons at generation, and the decay and energy loss of muons in the standard atmosphere. Values of the primary muon multiplicity are given for telescopes at sea level and at a depth of 60 m.w.e. underground. The response functions obtained are verified by comparison with experimental data on the latitude effect and equatorial east-west effect at sea level. Comparisons are also made with response functions proposed by other workers for telescopes at 60 m.w.e. (auth)

Radiometric Instruments

21254 (BM-RI-7807) CONTINUOUS MONITORING OF COAL BY A NEUTRON MOISTURE METER. Hall, A. W.; Konchesky, J. L.; Stewart, R. F. (Bureau of Mines, Washington, D. C. (USA)). 1973. 21p. GPO.

A nuclear method was developed for continuously and automatically determining the moisture content of coal flowing through a bin. Fast neutrons from a 1 Ci americium-beryllium source penetrate the coal, are thermalized (slowed down) by hydrogen in the moisture, and are counted by a thermal neutron detector. The difference between the number of these thermal neutrons and those thermalized by dry coal (in a reference drum) is a measure of the moisture content of the coal. A materials handling system was developed and in tests at a commercial coal preparation plant, moisture in coal was monitored continuously within 0.2 percent of values determined by conventional means. The meter responded rapidly to change in moisture content, making it adaptable to automatic process control, and was operated for 1 year without malfunction or recalibration. Shielding of the source by the coal kept the neutron flux level at the bin wall less than 1 milliroentgen per hour, a safe level for personnel. (auth)

21255 REPRESENTATION OF A RANDOM PROCESS AT THE OUTPUT OF A SCINTILLATION DETECTOR. Ovcharenko, A. M.; Nedavnii, O. I.; Kapranov, B. I. (Tomsk Polytechnic Inst., USSR). Sov. J. Nondestruct. Test. (Engl. Transl.); 9: No. 5, 549-553(1973).

Translated from Defektoskopiya; 9: No. 5, 50-55(1973).

The nature of the random process at the output of a scintillation detector is discussed for the case where gamma radiation from a radioisotope that has passed through a moving nonuniform absorber is incident at its input. It is shown that this results in an unsteady normal process, which can be represented in terms of a normal steady-state process. The basic characteristics are determined; i.e., the mathematical expectation, the variance, and the correlation function. (auth)

21256 CHOICE OF RADIATION ENERGY WHEN MEASURING THE GEOMETRICAL DIMENSIONS OF OBJECTS BY SCANNING WITH A BEAM OF IONIZING RADIATION. Valuev, N. P.; Latyshev, V. K.; Lyndin, V. V.; Mukomel, E. A. (Central Scientific-Research Inst. of Ferrous Metallurgy, Moscow). Sov. J. Nondestruct. Test. (Engl. Transl.); 9: No. 5, 545-548(1973).

Translated from Defektoskopiya; 9: No. 5, 47-50(1973).

The possibility of predetermining the optimum conditions for measuring the geometrical dimensions of steel parts by scanning with a beam of ionizing radiation, so as to achieve the minimum error with a minimum activity of the source of radiation, is demonstrated. Relationships are derived between the metrological characteristics of the measuring method and the product of the linear attenuation coefficient of the radiation and the thickness of the measured object, and the ranges of thickness of steel parts which may be measured with the radioisotopes cesium-137 and cobalt-60 are determined. (auth)

21257 MEASUREMENT OF THE DENSITY OF ORGANIC MEDIA WITH RESPECT TO THE ALBEDO OF GAMMA RADIATION (EXCHANGE OF EXPERIENCE). Voropaev, Yu. A.; Dubenskov, P. I.; Krasnoshchekov, N. V.; Pozdeev, D. B. (Gorky State Univ., USSR). Ind. Lab. (USSR) (Engl. Transl.); 39: No. 11, 1769-1770(Nov 1973).

Translated from Zavod. Lab.; 39: No. 11, 1364-1365(Nov 1973).

The results of density measurements performed by an operating model of the AGP albedo gamma-densimeter are reported. The AGP consists of an extension scintillation head and the measuring unit. A ^{60}Co source was used. Density measurements were made on cylindrical specimens of block polyethylene, boron carbide, serpentine filling, a mixture of serpentine filling and iron shot, and iron shot and the results given as a function of the medium density. The dependence of the readings on the thickness of cylindrical specimens and on the radius was determined. The advantages of the AGP over the mass produced PGP-1 were listed. (JSR)

21258 CALIBRATION CONTAINER FOR RADIOMETRIC DENSIMETER. Novakova, O.; Smola, J. Czech Patent 146,072. 15 Nov 1972. Filed date 31 Dec 1971. 2p.

A calibration container is proposed designed for a radiometric densimeter. It consists of a cylinder made of a homogeneous material having a density of 0.8 to 1.1 g/cm^3 (e.g., paraffin, polyethylene, etc.) and of a central guide tube for the calibrated probe placed in a bore along the cylinder axis. In the active region of the container, 8 channels are symmetrically arranged around the central guide tube. The channels serve for the insertion of bars made of materials with a density exceeding 6 g/cm^3 (e.g., lead). (Nuclear Sci. Abstr. Czech.)

21259 NEW TYPE DEW POINT HYGROMETER. Nakai, K.; Omori, H.; Goto, E.; Koyama, M. (Inst. of Physical and Chemical Research, Saitama, Japan). Rikagaku Kenkyusho Hokoku; 50: No. 2, 62-69(Mar 1974). (In Japanese).

A new type dew point hygrometer based on α absorption is described. This apparatus was designed for measuring the dew point continuously from 0 to 40°C under ordinary meteorological conditions. The density of air is changed by the temperature and pressure, therefore, the amount of absorption of α-rays is changed, also. In this apparatus such undesirable influences could be taken away by using a difference-type compensating circuit. As a result, holding and following of the dew point was obtained with an accuracy of less than 1% in the relative humidity. (auth)

21260 USE OF BACKSCATTERED GAMMA RADIATION FOR MEASUREMENTS OF DEPTH IMBEDDING AND SPACING OF STEEL CORDS IN RUBBER CONVEYOR BELTS. Gregor, T. (Research Inst. of Nuclear Instruments, Premysleni, Czech.); Musilek, L. Jad. Energ.; 20: No. 6, 186-190(Jun 1974). (In Czech).

The work concerns a study of a radioisotopic method destined for measurements of spacing and the depth of bedding of steel cords used for reinforcement of rubber conveyor belts. The backscattered gamma radiation of ^{241}Am is used for the simultaneous determination of both these parameters. The cord spacing is determined from the mutual position of the time dependent output signal extremes during uniform motion of the measuring probe along the belt to be measured, the depth of the bedding is proportional to the signal value in these extremes. Experimental results acknowledge the good serviceability of the proposed method. (auth)

21261 CHOICE OF A CRITERION FOR THE DEPTH RESPONSE OF A SURFACE GAMMA DENSITOMETER. Pavlov, L. S.; Terekhin, L. N. Meas. Tech. (USSR) (Engl. Transl.); 17: No. 2, 259-261(Feb 1974).

Translated from Izmer. Tekh.; 17: No. 2, 61-62(Feb 1974).

Relationships to describe the depth response of backscatter gamma densimeters are given to help in the interpretation of readings for technical monitoring. (WHK)

21262 WEIGHT PER UNIT AREA GAGES USING NUCLEAR RADIATIONS. P. 2. Design and Properties of Current Types of Equipment. Waechter, K. H. Arch. Tech. Mess. Messtech. Praxis; 455: No. 12, 225-228(Dec 1973). (In German).

4 figs.; 20 refs.

In the fabrication of sheets or continuous webs, the weight per unit area is an important quality criterion; in most cases it is measured by the absorption or backscattering of nuclear radiation. Different types of measuring systems and the following components are described: radiation source, detector and its positioning, and the electronic evaluation device. (GE)

21263 RADIOMETRIC DETERMINATION OF DENSITY USING THE BETA-RAY BACKSCATTERING METHOD. Ott, A. Materialpruefung; 16: No. 5, 132-134(May 1974). (In German).

Theoretical considerations as well as practical measurements have shown that special geometrical arrangements within the transducer will allow density measurements by means of the beta-ray backscattering method. The conditions and parameters governing such measuring equipment are described, various steps towards an optimization of the procedure are discussed, and several examples of the application of this method in practical density measurements are given. (GE)

Radiation Effects on Instrument Components, Instruments, or Electronic Systems

21264 (SAND-74-5209) BALANCING RELIABILITY, COST, AND HARDNESS. Hood, J. A. (Sandia Labs., Albuquerque, N. Mex. (USA)). Jul 1974. 22p. (CONF-740707-9). Dep. NTIS $4.25.

From annual conference on nuclear and space radiation effects; Fort Collins, Colorado, USA (15 Jul 1974).

The problem of balancing the cost and quality of piece parts (such as semiconductor devices) being procured was studied. Examples of data are given for the procurement of semiconductor devices. (WHK)

21265 (SLA-74-5030) RADIATION DEGRADATION IN MIXED RADIATION FIELDS. McKenzie, J. M. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1973. 8p. (CONF-740632-1). Dep. NTIS $4.00.

From international conference on evaluation of space environment; Toulouse, France (17 Jun 1974).

Degradation data on devices, circuits, or systems are required in order to harden against mixed radiation fluences. These fields can usually not be adequately produced by simulation machines. The functional dependence of a degradation parameter with fluence for each type of radiation is first established. Using the same sample device, an equivalence between different types of radiation is next established. This then enables a calculation of the degradation for the mixed radiation fluences. Neutron degradation is a special case since the method of neutron dosimetry (n/cm^2 per unit energy) reveals an energy dependence of neutron degradation. If, for example, gamma ray degradation has an energy dependence this is masked by the present dosimetry (rads Si). The change of drain current in a JFET in a mixed neutron and gamma field is used as an example of our present technique. The degradation functional dependence of each of four simulation neutron spectra is first established. The neutron spectra is then synthesized with the four spectra. Thus the equivalence of the neutron spectrum in terms of a simulation machine spectrum is obtained. Also the equivalence between the gamma field and the simulation machine neutron spectrum is obtained. These are now combined and the effect of the mixed neutron gamma field is expressed in an equivalent fluence of simulation machine neutrons. Errors and limitations of the method are discussed. (auth)

Miscellaneous Instruments

Refer also to abstracts 21671 and 22734.

21266 (CEA-N-1699) INTERMEDIATE MEMORY COUNTING SCALER. Time Base and Incorporated Key Punch Command. Rigaudiere, R. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Protection). Mar 1974. 27p. (In French). Dep. NTIS (US Sales Only) $4.50.

The scaler described was developed in order to repeatedly effect count measurements during predetermined time intervals with a minimum interruption of the measurements for the resulting output. When the measurement time terminates, the contents of the scaler are transferred to an intermediate memory; a new cycle can thus commence immediately, the time base automatically resetting itself. The keypunch command system interrogates the memory during the counting measurements. (FR)

21267 (FDA-74-8025) LINE VOLTAGE MONITOR FOR DETERMINING AC SUPPLY REGULATION TO A DIAGNOSTIC X-RAY SOURCE. Silberberg, J. L. (Department of Health, Education, and Welfare, Rockville, Md. (USA)). Jun 1974. 25p. GPO.

The Bureau of Radiological Health has developed a line voltage monitor for use by Food and Drug Administration personnel in determining compliance with the performance standard for diagnostic x-ray equipment. The instrument can be used to measure line voltage regulation to within ±0.1 percent and has a response time of 25 milliseconds. It is compact and lightweight and thus suitable for field use. (auth)

21268 (INIS-mf-1354) SPECIAL COAXIAL CABLES TO MINIMIZE THE SUSCEPTIBILITY TO ELECTRICAL INTERFERENCE OF NUCLEAR INSTALLATIONS. Vidal, M. J. B. (Instituto de Engenharia Nuclear, Rio de Janeiro (Brazil)). Dec 1972. 107p. (In Portuguese). INIS.

Thesis.

Special cables were studied that minimize the effects of external electrical interference in a system that operates with small signals (for example, nuclear systems); the interfering signal affects the behavior of the system after penetrating the shielding of cables and equipments. Two kinds of cables are presented, one antimicrofonic and the other with low transfer impedance and a special cable with extremely low transfer impedance is suggested. A method is presented for testing the sensitivity of a system to an interfering signal. (INIS)

21269 (INS-TH-85) TRIPLE dc LINEAR AMPLIFIER MODULE. Watanabe, S.; Mishina, M. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). 21 Dec 1973. 13p. (In Japanese). INIS.

A direct coupled, fast linear pulse amplifier of a fixed gain of 10 was designed. By the use of a complete negative feedback loop, a remarkably good linearity in the pulse height and fidelity in the pulse shape were achieved in a wide range of the input pulse height, 3 mV through 300 mV. The capable range of the input rate is from near to dc to 200 MHz. The drift of the output baseline is also kept quite small by another negative feedback loop. (auth)

21270 (JINR-D13-7616) CAMAC: PROCEEDINGS OF THE VII INTERNATIONAL SYMPOSIUM ON NUCLEAR ELECTRONICS,

BUDAPEST, SEPTEMBER 17–23, 1973. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1974. 371p. (In Russian and English). (CONF-7309110-).

A separate abstract was prepared for each of the 47 papers presented at the conference. (WHK)

For abstracts of individual papers see: 21189–21192, 21230–21236, 21246, 21247, 21271–21297, 21901, 21902, 21916, and 21932–21935.

21271 (JINR-D13-7616, pp 60-69) DATA ACQUISITION SYSTEM FROM UNCORRELATED EXPERIMENTAL INPUTS. Bals, I.; Caprini, M.; Goran, B.; Lutescu, S.; Niculescu, D. (Inst. for Atomic Physics, Bucharest). 1974.

From 7th international symposium on nuclear electronics; Budapest, Hungary (17 Sep 1973).

The system was designed as a small acquisition center for neutron physics experiments. The system can collect data from a maximum of 16 uncorrelated experimental inputs and store them in a 4K memory. A storage zone of $2^K \times 64$ bits (K = 1, 2, 3, 4) is reserved for each experiment. The system architecture and the functional units are described. (WHK)

21272 (JINR-D13-7616, pp 87-98) MEASUREMENT OF THE CHARACTERISTICS OF THE ANALOG UNITS IN THE CAMAC WITH A COMPUTER. Bespalova, T. V.; Golutvin, I. A.; Kiryushin, Yu. T.; Popov, A. A.; Fedunov, A. G.; Khabarov, V. S.; Yapunenko, Yu. A. (Joint Inst. for Nuclear Research, Dubna, USSR). 1974. (In Russian).

From 7th international symposium on nuclear electronics; Budapest, Hungary (17 Sep 1973).

The electronic apparatus in the CAMAC installation makes possible the rapid and accurate determination of the characteristics of analog devices. By means of digital-analog and analog-digital converters the characteristics of individual blocks and chains of the measurement channels can be measured. The methods used for the calibration of some of these measurement channels are described. (JSR)

21273 (JINR-D13-7616, pp 105-113) SYSTEM FOR THE CONSTRUCTION OF EXECUTIVE SUBPROGRAMS FOR MINI-COMPUTERS OPERATING WITH ADDITIONAL MEMORY. Lang, I. (Joint Inst. for Nuclear Research, Dubna, USSR). 1974. (In Russian).

From 7th international symposium on nuclear electronics; Budapest, Hungary (17 Sep 1973).

The type and quality of variable subprograms strongly affects the selection of the construction system of executive subprograms. Some solutions for this problem are discussed. These include change of the usual standard subprogram, method for variation of fragments of the program, use of the commonly framed subprogram, two-word subprogram, method of universal central lock, and construction of an executive interpreter subprogram. (JSR)

21274 (JINR-D13-7616, pp 114-116) POSSIBILITY OF ON-LINE OPERATING SYSTEMS FOR MEASUREMENT CONTROL ON SMALL COMPUTERS. Ero, J.; Lang, I.; Pocs, L. (Central Research Inst. for Physics, Budapest). 1974.

From 7th international symposium on nuclear electronics; Budapest, Hungary (17 Sep 1973).

The requirements of a small on-line computer for data acquisition and transfer, preliminary evaluation, data display and measurement control are briefly discussed. (WHK)

21275 (JINR-D13-7616, pp 119-123) LOGIC OF THE COMMUNICATION LINE FOR THE BESM-4 COMPUTER WITH EXPERIMENTS. Koba, T.; Kolpakov, I. F.; Dul'ski, R.; Raditski, P. (Joint Inst. for Nuclear Research, Dubna, USSR). 1974. (In Russian).

From 7th international symposium on nuclear electronics; Budapest, Hungary (17 Sep 1973).

Block diagrams of the communication line and of the IKB-581 interface are given. The controller introduces appropriate regimes as a function of the status of the recordings at the interface. (JSR)

21276 (JINR-D13-7616, pp 124-127) MULTIPLEX CHANNEL OF A MULTIDIMENSIONAL MEASUREMENT SYSTEM WITH A SMALL COMPUTER. Nefed'ev, O. K.; Nguen Khak Tkhi; Chelnokov, L. P. (Joint Inst. for Nuclear Research, Dubna, USSR). 1974. (In Russian).

From 7th international symposium on nuclear electronics; Budapest, Hungary (17 Sep 1973).

The multiplex (program-control) channel containing a minimum bulk of equipment which connects the TRA-1001 computer with different types of measurement systems is described. Its characteristics and operation are briefly reported. Both measurement device- and computer-initiated exchange of data are possible. (JSR)

21277 (JINR-D13-7616, pp 128-162) APPARATUS AND COUPLING PROGRAMS OF THE ELECTRONIC UNITS USED IN THE CAMAC STANDARD WITH THE ELECTRONIKA-100, RDR-8, AND M-6000 COMPUTERS. Bespalova, T. V.; Golutvin, I. A.; Komogorova, L. V.; Smolin, D. A.; Fedunov, A. G. (Joint Inst. for Nuclear Research, Dubna, USSR). 1974. (In Russian).

From 7th international symposium on nuclear electronics; Budapest, Hungary (17 Sep 1973).

Three new apparatus and coupling programs used in the CAMAC system coupled with computers are described. These are the special controller (type 014) for computers of the Elektronika-100 and RDR-8 type (a modification of this controller makes it possible to use the RDR-8/L computer), a special controller (type 017) for the M-6000 computer, and the interface for connecting the multicrate system (number of crates up to 7) with the M-6000 computer. The details and specifications of each of these are described. (JSR)

21278 (JINR-D13-7616, pp 163-165) MULTICRATE SYSTEM IN THE CAMAC STANDARD ON LINE WITH THE NR2116V COMPUTER. Kolpakov, I. F.; Nikityuk, N. M.; Smirnov, V. A.; Chernykh, E. V. (Joint Inst. for Nuclear Research, Dubna, USSR). 1974. (In Russian).

From 7th international symposium on nuclear electronics; Budapest, Hungary (17 Sep 1973).

A four-crate system of the CAMAC on-line with the NR2116V computer, designed for the acquisition and storage of experimental high-energy physics data is described. Two interface crates in the inlet-outlet system of the computer are connected with a driver branch. The fourth crate is a specialized controller NR-KTR (type 604). This system is described. (JSR)

21279 (JINR-D13-7616, pp 166-174) SYSTEM FOR THE MATHEMATICAL CONTROL OF THE CAMAC FOR TRA COMPUTERS. Almashi, L.; Gereg, P.; Lukach, I. (Central Research Inst. for Physics, Budapest). 1974. (In Russian).

From 7th international symposium on nuclear electronics; Budapest, Hungary (17 Sep 1973).

The command system of the CAMAC-TRA/1 is outlined. The means of programming the CAMAC modules are discussed. (JSR)

21280 (JINR-D13-7616, pp 177-180) OPTIMUM USE OF MINI-COMPUTERS IN PROBLEMS OF AUTOMATION OF MEASUREMENTS. Fefilov, B. V. (Joint Inst. of Nuclear Research, Dubna, USSR). 1974. (In Russian).

From seventh international symposium on nuclear electronics; Budapest, Hungary (17 Sep 1973).

In the use of specialized software for automatic measurement systems based on the use of minicomputers it is necessary to have teletypes, input-output with punched tape, and the simplest display. The interface with the measurement devices is developed from the necessity of coordinating the experiment and the instrument parameters. Each of these points is briefly discussed in a review of the developments of the use of minicomputers in measurement automation. (JSR)

21281 (JINR-D13-7616, pp 181-186) HUMAN–MINICOMPUTER DIALOG. Lang, I.; Fefilov, B. V.; Chelnokov, L. P. (Joint Inst. of Nuclear Research, Dubna, USSR). 1974. (In Russian).

From seventh international symposium on nuclear electronics; Budapest, Hungary (17 Sep 1973).

The most difficult questions remaining in human–computer dialog systems are the problem of the type of display and the language to be used; these are discussed. Typical block diagrams of oscillographic and television displays are given. A circuit is given for the interpretation of the keyboard command. (JSR)

21282 (JINR-D13-7616, pp 187-193) OPTICAL TWO-WAY INSTALLATION FOR CONNECTING MAN WITH A MINICOMPUTER (MODUS/1). Gryaznov, V. M.; Tomik, I. (Joint Inst. of Nuclear Research, Dubna, USSR). 1974. (In Russian).

From seventh international symposium on nuclear electronics; Budapest, Hungary (17 Sep 1973).

The MODUS/1, a visual communications apparatus for the processing of experimental data, is described in detail. The MODUS/1 consists of three units: the indicator unit, the logic unit, and the coupling unit. The structure of the access to the computer is shown. (JSR)

21283 (JINR-D13-7616, pp 194-203) GRAPHIC AND ALPHABIT-DIGITAL DISPLAY WITH A LIGHT PENCIL. Duda, F.; Feiferlik, V.; Vlchek, Z. (Inst. of Nuclear Physics, Rez, Czechoslovakia). 1974. (In Russian).

From seventh international symposium on nuclear electronics; Budapest, Hungary (17 Sep 1973).

Some technical data and examples of the use of universal displays with a light pencil developed at the Institute of Nuclear

Physics are briefly reported. A technical description of the display and its block diagram is given. The use of the display for spectrometric measurements is discussed. (JSR)

21284 (JINR-D13-7616, pp 204-208) SIMPLE DISPLAY FOR THE KRS-4200 COMPUTER (ROBOTRON). Mailing, V. (Technical Univ., Dresden). 1974. (In Russian).
From seventh international symposium on nuclear electronics; Budapest, Hungary (17 Sep 1973).
In order to use the computer in the regime of multichannel analyzers, a display showing the spectra stored in the computer memory is necessary. The display system developed is described. For input-output of data to the computer the AS3 and SI 2.2 channels were used, and a commercial oscillograph was used for display. The block diagram of the installation is given, and the requirements for oscillographic control are tabulated. The control hardware is shown in a block diagram. (JSR)

21285 (JINR-D13-7616, pp 209-216) APPLICATION OF THE DISPLAY FOCAL PROGRAM IN THE SCIENTIFIC RESEARCH. Sandor, T. L. (Central Research Inst. for Physics, Budapest). 1974.
From seventh international symposium on nuclear electronics; Budapest, Hungary (17 Sep 1973).
The FOCAL is an on-line, conversational, interpretative language for small computers. The Display Focal Program, developed for the NE-601/1 Raster Type Display for the TPA/1 Small Computer, is described. (WHK)

21286 (JINR-D13-7616, pp 221-223) AUTOMATION OF GRAPHIC PLOTTING BY MEANS OF THE TRA-1001 SMALL COMPUTER. Nguen Khak Tkhi. (Joint Inst. for Nuclear Research, Dubna, USSR). 1974. (In Russian).
From seventh international symposium on nuclear electronics; Budapest, Hungary (17 Sep 1973).
For construction of different types of graphs and contour lines, particularly for construction of one-dimensional and two-dimensional spectra, the use of the small computer TRA-1001 in conjunction with the two-coordinate recorder with a converter installation UP-7 is proposed. The characteristics of the system developed are described. (JSR)

21287 (JINR-D13-7616, pp 238-240) VEGA: INTERPRETIVE PROGRAM FOR PROCESSING MEASUREMENTS IN NUCLEAR PHYSICS. Pernetski, G. (Central Research Inst. for Physics, Budapest). 1974. (In Russian).
From seventh international symposium on nuclear electronics; Budapest, Hungary (17 Sep 1973).
A block diagram of the VEGA interpretative program is given. The master file of the program, procedure U1, is in file B, whose block diagram is also given. (JSR)

21288 (JINR-D13-7616, pp 243-253) DEVELOPMENT OF THE CAMAC SYSTEM. Trechcinski, R. 1974.
From seventh international symposium on nuclear electronics; Budapest, Hungary (17 Sep 1973).
Some future problems connected with the development of the CAMAC system are summarized. (WHK)

21289 (JINR-D13-7616, pp 254-262) CONTROL MODULES DEVELOPED AT THE CENTRAL INSTITUTE FOR PHYSICS RESEARCH. Karadi, P.; Hemesh, T.; Sani, L. (Central Research Inst. for Physics, Budapest). 1974. (In Russian).
From seventh international symposium on nuclear electronics; Budapest, Hungary (17 Sep 1973).
The CAMAC modules, connected as external devices to the small computers TRA/1 and TRA-70, are described in a general manner. The control unit and the combined control unit are described in more detail. (JSR)

21290 (JINR-D13-7616, pp 263-275) CAMAC MODULES DEVELOPED IN THE CENTRAL INSTITUTE FOR PHYSICS RESEARCH. Biri, Ya.; Maroshi, K.; Nemesh, T.; Shinka, F.; Shomlai, L.; Shomlai, L-ne; Tsigel'man, K. (Central Research Inst. for Physics, Budapest). 1974. (In Russian).
From seventh international symposium on nuclear electronics; Budapest, Hungary (17 Sep 1973).
A brief review is given of the general concepts used in the design of CAMAC modules. The principles in the fabrication of the main panel and unsoldering of the connections are discussed. The general principles for the design of the primary circuit are given. (JSR)

21291 (JINR-D13-7616, pp 276-288) ANALOG AND DIGITAL UNITS USED IN THE CAMAC. Golutvin, I. A.; Zamyatin, N. I.; Kondrashov, V. D.; Mel'nichenko, I. M.; Popov, A. A.; Smolin, D. A.; Khabarov, V. S. (Joint Inst. for Nuclear Research, Dubna, USSR). 1974. (In Russian).
From seventh international symposium on nuclear electronics; Budapest, Hungary (17 Sep 1973).
The characteristics of the basic units in the CAMAC are described. The units considered are an analog-digital converter, digital-analog converter, 20 MHz pulse counter (type 015), 50 MHz pulse counter, and the intermediate memory (type 021). The operating regime of the units is outlined. (JSR)

21292 (JINR-D13-7616, pp 305-310) FAST ANALOG-TO-DIGITAL CONVERTERS IN THE CAMAC. Basiladze, S. G.; Man'yakov, P. K.; Tlachala, V. (Joint Inst. for Nuclear Research, Dubna, USSR). 1974. (In Russian).
From seventh international symposium on nuclear electronics; Budapest, Hungary (17 Sep 1973).
The characteristics of the fast analog-to-digital converters including the values of the amplitudes, charges, and time intervals are described. Block diagrams are given of each. Circuits for the non-linear current amplifier, Schmitt trigger, and pulse generator of the charge-digital converter and for the input part of the charge-digital converter are given. (JSR)

21293 (JINR-D13-7616, pp 311-317) FAST ELECTRONIC UNITS WITH COMPUTER CONTROL. Aref'ev, V. A.; Basiladze, S. G. (Joint Inst. for Nuclear Research, Dubna, USSR). 1974. (In Russian).
From seventh international symposium on nuclear electronics; Budapest, Hungary (17 Sep 1973).
The types of fast electronic units with computer control developed at the JINR and their principal characteristics are tabulated. Typical results obtained with these units are shown graphically. (JSR)

21294 (JINR-D13-7616, pp 318-327) OFF-LINE PROCESSING MODULE IN THE CAMAC SYSTEM. Aref'ev, V. A.; Belyakova, M. P.; Dul'ski, R. (Joint Inst. for Nuclear Research, Dubna, USSR). 1974. (In Russian).
From seventh international symposium on nuclear electronics; Budapest, Hungary (17 Sep 1973).
The off-line processing modules in the CAMAC system can be divided, according to their purpose, into the following classes: converters, recorders and counters, interfaces of the instrument and the display, controllers, generators, and branch modules. The design and characteristics of each of these types of modules are described. (JSR)

21295 (JINR-D13-7616, pp 328-331) CAMAC–CAMAC DATA TRANSMISSION SYSTEM. Rydzewski, T.; Komor, Z. (Inst. of Nuclear Research, Swierk, Poland). 1974.
From seventh international symposium on nuclear electronics; Budapest, Hungary (17 Sep 1973).
A link for the parallel transfer of data between two asynchronous CAMAC systems is described. Both CAMAC systems have to include either their own computers or their own autonomous processors. The data transmission link consists of two double-width CAMAC transmitter-receiver modules and a transmission line. The system is fully bidirectional. Each CAMAC system can initiate the transfer and fix its direction. (auth)

21296 (JINR-D13-7616, pp 333-336) SYSTEM FOR THE INPUT OF DIGITAL DATA FROM A DIGITIZER AND PUNCHED TAPE INTO THE CAMAC. Belyakova, M. P.; Nguen Fuk; Khmelevski, E.; Urmanova, L. A. (Joint Inst. for Nuclear Research, Dubna, USSR). 1974. (In Russian).
From seventh international symposium on nuclear electronics; Budapest, Hungary (17 Sep 1973).
The purpose of the input system is briefly outlined, and its properties and characteristics are given. The organization for the output of data from the digitizer or perforator is described. (JSR)

21297 (JINR-D13-7616, pp 368-371) DIGITAL RATE METER. Vankov, I. D.; Geogriev, S. A. 1974. (In Russian).
From seventh international symposium on nuclear electronics; Budapest, Hungary (17 Sep 1973).
In the case of most ratemeters designed up to the present, either the data are obtained with some delay equal to the averaging time or there is a relatively long time for obtaining the final results. A method is outlined for the fabrication of ratemeters which to a significant degree eliminates these deficiencies. A block diagram of the device is given and its operating characteristics are outlined. (JSR)

21298 (KFK-EXT-6/74-3) EXPERIENCES WITH THE LIQUID METAL OXYGEN METER OF GULF UNITED NUCLEAR CORPORATION IN SODIUM CIRCUITS. Borgstedt, H. U.; Drechsler, G.; Frees, G.; Wittig, G. (Kernforschungszentrum Karlsruhe (F.R. Germany)). May 1974. 30p. (In German). Dep. NTIS (US Sales Only) $4.50.

The experience with emf-oxygen meters is mainly favorable in five years of operation of several commercial cells. The oxygen content of liquid sodium of experimental sodium rigs can be monitored continuously by the electrochemical method and concentration changes recorded quickly. The actual values of oxygen concentration can be read at the switchboard. The sensitivity of the ceramic electrolyte material ThO_2 with 15 w/% Y_2O_3 to thermal shocks and the necessity to calibrate each individual sensor are disadvantages. The individual sensors do not agree among themselves and with theoretical values. The use of emf cells does not eliminate the need for analytical oxygen measurements but can reduce the frequency of chemical analyses. (auth)

21299 (LMEC-TDR-74-8) CRITIQUE OF PRESENT AND POSSIBLE FUTURE SODIUM FLOW MEASUREMENT TECHNIQUES. Turner, G. E. (Liquid Metal Engineering Center, Canoga Park, Calif. (USA)). 2 Apr 1974. Contract AT(04-3)-700. 13p. AT.

The advantages and disadvantages of presently used sodium flow measurement techniques are briefly discussed. Two relatively new flow measurement technologies, ultrasonic and hydraulic oscillation, are discussed in more detail and a testing program is recommended to determine their applicability for sodium flow measurement. (auth)

21300 (SAND-74-0009) BIBLIOGRAPHY: SANDIA LABORATORY HYBRID MICROCIRCUIT AND RELATED THIN FILM TECHNOLOGY. Tapp, C. M.; Traeger, R. K. (Sandia Labs., Albuquerque, N. Mex. (USA)). Jun 1974. Contract AT(29-1)-789. 40p. Dep. NTIS $5.00.

Sandia originated documents describing aspects of technology development related to hybrid microcircuits and thin films for nuclear weapon applications are summarized. Authors, titles, and abstracts are given for each unclassified document. The papers are categorized according to the various technologies involved in hybrid microcircuit production. (auth)

21301 OPTICAL INSTRUMENTATION ENGINEERING IN SCIENCE, TECHNOLOGY, AND SOCIETY. Proceedings of the Society of Photo-optical Instrumentation Engineers 16th Annual Technical Meeting, San Mateo, California, October 16–18, 1972. Volume 4. Katz, Y. H. (ed.). Redondo Beach, CA; Society of Photo-Optical Instrumentation Engineers (1973). 306p. (CONF-721032-).

A separate abstract was prepared for each of 2 papers presented at the meeting. The remaining 35 papers were not in scope for NSA. (WHK)

For abstracts of individual papers see: 21009 and 21208.

21302 POWER SUPPLIES FOR THE NEW MODULAR INSTRUMENTATION SYSTEM OF NUCLEAR ELECTRONICS. Kubalek, J. (Interatominstrument, Warsaw). Jad. Energ.; 20: No. 6, 200-202 (Jun 1974). (In Czech).

The required properties of the power supplies for the new modular instrumentation system of nuclear electronics are described. References on the circuitry and design conception of the stabilized power supplies and their overvoltage and overcurrent protections are given. (auth)

21303 COMPUTING WITH REAL-TIME SYSTEMS. Volume 2. Proceedings of the Second European Seminar Held at Erlangen-Nuernberg, Germany. Pyle, I. C.; Elzer, P. (eds.). London; Transcripta Books ([nd]). vp.

Twenty-one papers were presented in sections entitled: general considerations on real-time programming, basic design principles of operating systems, components of real-time systems, and special systems and system features. One paper in the section covering special systems and system features was in NSA scope for which a separate abstract was prepared. (UK)

For an abstract of an individual paper see: 21242.

ISOTOPE AND RADIATION SOURCE TECHNOLOGY

Isotope Separation (Industrial)

Refer also to abstracts 21012, 21015, and 23289.

21304 (AECL-4667) CHARACTERIZATION OF SUPPORTED METAL CATALYSTS BY GAS CHEMISORPTION IN A CONTINUOUS FLOW SYSTEM. Wikjord, A. G.; Munson, W. P. (Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment). Mar 1974. 31p. (CONF-730661-2). Dep. NTIS (US Sales Only) $4.75. AECL $1.00.

From 56th annual CIC meeting on the effects of surface films on the initiation of stress corrosion cracking of zircaloy-2; Montreal, Canada (4 Jun 1973).

A continuous flow system is described which uses a modified Perkin-Elmer Sorptometer with thermal conductivity detectors to measure chemisorption of gases on supported metal catalysts. Two methods, one based on a pulse adsorption procedure and the other on thermodesorption, were employed to estimate the adsorptive capacity of supported platinum and palladium catalysts. Hydrogen and carbon monoxide served as adsorbates. In some instances the results were compared to those obtained by the conventional static volumetric method. It was found that for precise quantitative work using the flow method, close attention must be given to detector calibration. The main advantage of the method is its speed of analysis; it offers a substantial saving of time in comparison to conventional measurements in static systems. (auth)

21305 (AERE-R-6758) TECHNIQUES FOR THE PRODUCTION OF HEAVY ION BEAMS. Freeman, J. H.; Gard, G. A.; Temple, W. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Mar 1971. 29p. Dep. NTIS (US Sales Only) $4.50.

A description of the various ion source techniques used on the Harwell experimental isotope separators is given. Source constructional material problems are discussed and methods for the preparation of source feed compounds are reviewed. A comprehensive table of operational procedures for most elements is included. (auth)

21306 (LA-5630-MS) LASER-ENHANCED CHEMICAL REACTIONS AND THE LIQUID STATE: AN INTRODUCTION. Rofer-DePoorter, C. K.; DePoorter, G. L. (Los Alamos Scientific Lab., N. Mex. (USA)). Jun 1974. Contract W-7405-eng-36. 18p. Dep. NTIS $4.00.

Laser enhancement of chemical reactions has mostly been studied in the gaseous state, but cannot be ruled out for the liquid state. Laser enhancement of reactions taking place in the liquid state could have important economic consequences for many industrial chemical processes. Physical and chemical principles involved in laser enhancement of chemical reactions are reviewed, and relevant literature is discussed. (auth)

21307 (UCRL-75545(Rev.1)) ISOTOPE SEPARATION BY LASER RADIATION PRESSURE DEFLECTION OF AN ATOMIC BEAM. Bernhardt, A. F.; Duerre, D.; Simpson, J.; Wood, L. L.; Goldsborough, J.; Jones, C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 7 Jun 1974. 8p. (CONF-740617-7). Dep. NTIS $4.00.

From eighth international quantum electronics conference; San Francisco, California, USA (10 Jun 1974).

The results of a barium isotope separation experiment in which a single isotopic component of an atomic beam was selectively deflected by resonant scattering of laser light are presented. (TFD)

21308 HEAVY WATER PRODUCTION. Haywood, L. R. (Atomic Energy of Canada Ltd., Montreal). Nucl. Eng. Int.; 19: No. 217, 506-507(Jun 1974).

The history of heavy water production in Canada is briefly discussed. Production processes and the economics of production are summarized. Capacity by 1980 is expected to reach nearly 600 kg/h. Current programs include deuterium separation by the GS process, and research and development on alternatives to the GS process. (UK)

21309 URANIUM ENRICHMENT BY GAS CENTRIFUGE. Avery, D. G.; Davies, E. M and B Technical Library TL/CE/2. London; Mills and Boon Ltd. ([nd]). 73pp.

The subject is dealt with in sections: principles of isotope separation (methods of isotope separation, basic isotope separation theory); gas centrifuge (theory of the centrifuge, types of centrifuge); engineering design of centrifuges; centrifuge plant (centrifuge cascades, ideal cascades, practical cascades); economics and future developments. Appendices deal with the following: (1) maximum separative power of a centrifuge, (2) general partial differential equation for a centrifuge, (3) partial differential equation of the countercurrent centrifuge, and (4) flow profiles. (UK)

21310 EXPECTED DEVELOPMENTS IN HEAVY WATER TECHNOLOGY. Blake, L.; Petryschuk, W. F.; Rae, H. K. Paper No. CNA'73-603 of Proceedings of the Thirteenth Annual International Conference of the Canadian Nuclear Association. Toronto; Canadian Nuclear Association (1973).

From 13th annual international conference of the Canadian Nuclear Association; Toronto, Ontario (17 Jun 1973).

Developments in heavy water production technology in Canada are expected in three areas: plant operation, GS process improvement, and new processes. Mature, high capacity operation of the current plants will be achieved by a combination of operating experience and extensive technical support and laboratory development work. The next generation of GS plants will include improvements in process arrangement and equipment design to increase reliability and production efficiency. One of the new processes, steam-hydrogen-amine exchange or hydrogen-water exchange, may have sufficient potential to achieve commercial operation; their main advantages are smaller equipment, less hazardous and corrosive fluids, and lower energy consumption. (CA)

21311 SOME PHYSICAL AND CHEMICAL ASPECTS OF TWO PROPOSED METHODS OF HEAVY WATER SEPARATION. McConnell, D. B. (Ontario Hydro, Toronto). Paper No. CNA'73-TS-4 of Proceedings of the Thirteenth Annual International Conference of the Canadian Nuclear Association. Toronto; Canadian Nuclear Association (1973).

From 13th annual international conference of the Canadian Nuclear Association; Toronto, Ontario (17 Jun 1973).

The two novel techniques for heavy water separation are selective photochemical activation and dielectrophoresis. The former is based on the different spectral properties of hydrogen compounds. For example, according to S. W. Mayer et al., methanol containing light hydrogen can be separated from its deutero-derivative by photochemical reaction with bromine initiated by infrared radiation from a hydrogen-fluoride laser. The second method is based on the different mobilities of light and heavy steam in an inhomogeneous electric field; the difference results from their different dipole moments. No new work on the first method is reported, but the author's dielectrophoretic apparatus is described and depicted. (CA)

21312 ACCURATE KINETICS EQUATIONS OF A SQUARE CASCADE FOR GAS SEPARATION. Yamashita, S. (Sumitomo Atomic Energy Industries, Ltd., Tokyo). Nucl. Sci. Eng.; 54: No. 4, 432-444(Aug 1974).

Accurate kinetics equations, which can be applied to a square and to a two-step gas-separation cascade composed of stages with a large separation factor, are derived from the exact conservation of matter in the unsteady state. The derivation is based on the assumptions that flow rates and holdups are independent of time and that the second derivative of the assay with respect to time can be neglected. If two or three additional assumptions, including the important one that the separation factor is nearly equal to unity, are added to those above, the equations reduce to Cohen's kinetics equations. If a square cascade with eight stages composed of separators having a separation factor of 1.1 is supposed to be operated in total reflux, the results of the calculations disclose that the assays and the 98% equilibrium times obtained from the conventional equations are overestimated by ~12 and ~10%, respectively, compared with those obtained from the equations. The kinetics equations promise to be useful for analyzing the kinetics of a square cascade with a large separation factor such as a centrifuge. (auth)

21313 URANIUM ENRICHMENT: LASER METHODS NEARING FULL-SCALE TEST. Metz, W. D. Science; 185: No. 4151, 602-603(16 Aug 1974).

The laser isotope separation method for uranium is briefly described. The efforts of Exxon-Avco and the USAEC are discussed. (TFD)

Isotopic Power Sources

Refer also to abstracts 20917–20920, 21514, and 21635.

21314 (AED-Conf-74-030-001) NATIONAL REGULATIONS CONCERNING THE APPLICATION OF CARDIAC PACEMAKERS

WITH RADIONUCLIDE BATTERIES. Pfaffelhuber, J. K. 1974. 26p. (In German). INIS.

From symposium on safety aspects of implanted cardiac pacemakers, with special regard to radionuclide batteries; Berlin, F. R. Germany (1 Mar 1974).

With tabs. With abstract.

The paper deals with the following: survey of currently applicable legal provisions; competences with regard to legislation and the execution of legal provisions within the framework of the atomic energy law and the radiation protection ordinance; legal provisions concerning the handling and use of cardiac pacemakers with radioisotope batteries; and legal consequences of non-observance of radiation protection regulations. (GE)

21315 (AED-Conf-74-030-002) CONTROL AND INSPECTION PROBLEMS WITH RESPECT TO RADIATION PROTECTION AND HEALTH PHYSICS. Rosenbaum, O. 1974. 9p. (In German). INIS.

From symposium on safety aspects of implanted cardiac pacemakers, with special regard to radionuclide batteries; Berlin, F. R. Germany (1 Mar 1974).

With abstract.

For legal reasons, control and monitoring measures by the legal authorities may only relate to the handling of cardiac pacemakers equipped with radioisotope batteries, e.g., during the process of fabrication, during storage and implantation and removal. The term "handling" in the legal meaning does not include the carrying of such pacemakers and patients and therefore, not subject to governmental control. All other control measures, however, are deemed to be necessary in order to guarantee the required protection from hazards resulting from the handling of radioisotope batteries and to ensure that all persons concerned are aware of the risks involved. (GE)

21316 (AED-CONF-74-030-005) INTERNATIONAL REGULATIONS, AGREEMENTS AND RECOMMENDATIONS FOR CARDIAC PACEMAKERS WITH RADIONUCLIDE BATTERIES. Mehl, W. G. (Bundesministerium des Innern, Bonn (F. R. Germany)). 1974. 10p. (In German). INIS.

From symposium on safety aspects of implanted cardiac pacemakers, with special regard to radionuclide batteries; Berlin, Ger. (1 Mar 1974).

The basic recommendations of ICRP, given in the publications No. 9 and 22, are briefly discussed. The Nuclear Energy Agency of the OECD is currently working out regulations concerning the protection of patients carrying radioisotope pacemakers, and of individual members of the population as well as the population as a whole, from the hazards associated with the application of these devices. These regulations are based upon the recommendations of the ICRP. The paper reviews the regulations as far as available so far and discusses the monitoring and control system and the risk-benefit analysis demanded by the NEA. (GE)

21317 (ALO-2832-46) EVALUATION OF A MOLYBDENUM FOIL–QUARTZ CLOTH INSULATION SYSTEM AFTER 18,000 HOURS AT A SOURCE TEMPERATURE OF ~1100°C (2012°F). McLaughlin, D.; Nowobilski, J. J.; Webster, D. J.; Zawierucha, R. (Union Carbide Corp., Indianapolis, Ind. (USA). Linde Div.). Jun 1973. Contract AT(29-2)-2832. 43p. Dep. NTIS $5.25.

The objectives of this program are to evaluate and demonstrate long term thermal performance stability of multi-layer insulation at source temperatures up to 1100°C for use in radioisotope power systems. Two multi-layer insulation systems were selected for long term stability testing at a source temperature of 1100°C in high vacuum. Molybdenum foil-quartz cloth was maintained at stability test conditions for 18,020 h. Upon completion of this duration the system was disassembled for post test analysis. The results of the ensuing evaluation are presented. Molybdenum foil-zirconia cloth was maintained at stability test conditions for 10,000 h. The results of the post test analysis are presented in report ALO 2832-45. (auth)

21318 (ANSP-M-1) REVIEW OF GRAPHITE ABLATION THEORY AND EXPERIMENTAL DATA. Perini, L. L. (Johns Hopkins Univ., Silver Spring, Md. (USA). Applied Physics Lab.). Dec 1971. 62p. Dep. NTIS $6.25.

Theoretical graphite ablation models and supporting experimental data are reviewed with the purpose of determining the degree of confidence to be placed in predictions of graphite ablation from the methods currently in use. From this review of theory and data available to date, it is recommended, for the present, that graphite mass loss predictions for the Pioneer F fuel capsule reentries be based on "moderate" oxidation rates (following Metzger, et al.), Scala's CO diffusion limit, and a thermochemical model for the high temperature sublimation regime based on JANAF(69) species data along with an empirical correlation for erosion losses. (auth)

21319 (ANSP-M-2) PIONEER F/SNAP 19 HEAT SOURCE ABLATION STUDIES. Conn, D. W. (Johns Hopkins Univ., Silver Spring, Md. (USA). Applied Physics Lab.). Feb 1972. 54p. Dep. NTIS $5.75.

A series of studies were conducted to assess the ablation performance of the Pioneer F/SNAP 19 heat source for various analytical thermochemical and mechanical erosion models. One of the specific objectives of this study was to evaluate the oxidation cut-off concept employed in past reentry safety analyses vs more physically representative oxidation models. It also afforded an opportunity to obtain a gross assessment of heat shield performance for oxidation models representative of the graphite mass loss data measured at (a) General Electric and (b) NASA Langley Research Center. These studies were extended to investigate the effects of different graphite sublimation models on heat shield performance and attempted to consider "mechanical erosion" effects heretofore omitted in reentry safety analyses. Finally, uncertainties, present in current graphite ablation predictive techniques and specifically, within the recommended model of these studies, are discussed and demonstrated in terms of heat source ablation performance. (auth)

21320 (ANSP-M-3) PIONEER F/SNAP 19 HEAT SOURCE THERMAL ANALYSIS. Conn, D. W.; Frazer, R. K. (Johns Hopkins Univ., Silver Spring, Md. (USA). Applied Physics Lab.). Apr 1972. 41p. Dep. NTIS $5.25.

As part of the nuclear safety analysis for the Pioneer F/SNAP 19 power system, a two-dimensional thermal analysis of the SNAP 19 heat source was conducted for several mission abort reentries. This report presents the results of the analysis and compares the heat source's critical thermal parameters with the predictions resulting from Teledyne Isotopes' nuclear safety studies. Discussion is also included on (a) the special considerations given the orbital decay thermal analysis and (b) the cost/accuracy optimization trade-off conducted for the modelling of the graphite heat shield. (auth)

21321 (ANSP-M-4) COMPILATION AND CORRELATION OF EXPERIMENTAL, HYPERSONIC, STAGNATION POINT CONVECTIVE HEATING RATES. Perini, L. L. (Johns Hopkins Univ., Silver Spring, Md. (USA). Applied Physics Lab.). Jul 1972. 45p. Dep. NTIS $5.25.

Experimental shock-tube data for the aerodynamic heating at the stagnation point on spherical bodies at superorbital and suborbital flight velocities (U_0) have been compiled from a number of sources and compared to theoretical predictions. It was found that the empirical correlation given by Detra, Kemp and Riddell is remarkably close to a least-squares fit of the data. It is therefore recommended that their correlation be used for continuum flow theoretical predictions of the laminar hypersonic convective stagnation-point heating rate to spherical bodies in the region, U_0 = 6000 to 58,000 ft/sec. (auth)

21322 (ANSP-M-5) CURVE FITS OF JANAF THERMOCHEMICAL DATA. Perini, L. L. (Johns Hopkins Univ., Silver Spring, Md. (USA). Applied Physics Lab.). Sep 1972. 37p. Dep. NTIS $5.00.

The constants required for equations for molar enthalpy and molar entropy as functions of temperature are presented for each of the approximately 1100 chemical species (involving 31 chemical elements) in the JANAF tabulations. These constants, determined by the least-squares technique, are given for two different mathematical representations of the data, one each for use with the thermochemical computer codes that were originated by the Aerotherm Corporation (their Equilibrium Surface Thermochemistry code) and the Naval Ordnance Test Station. These codes are used at the Applied Physics Laboratory for a variety of thermochemical problems (e.g., ablation, flow field analysis, and fuel/propellant performance). Where possible (depending on the upper limit of the JANAF data for a given species), the curve fits extend from 400 to 6000°K. All equations are strictly applicable only for a species partial pressure of one atmosphere. (auth)

21323 (ANSP-M-6) USERS MANUAL FOR THE 3DOF TRAJECTORY COMPUTER PROGRAM. Perini, L. L. (Johns Hopkins Univ., Silver Spring, Md. (USA). Applied Physics Lab.). Sep 1973. 66p. Dep. NTIS $6.50.

This report documents the three-degree of freedom (3DOF) reentry trajectory computer code employed in the Atomic Energy Commission Aerospace Nuclear Safety Program at the Applied Physics Laboratory. The code is written in Fortran and is operational on the IBM 360/91. A sample input deck setup is illustrated. (auth)

21324 (ANSP-M-7) EVALUATION OF METHODS USED TO DETERMINE TEMPERATURES OF CONVECTIVELY HEATED SOLID SURFACES. Randall, J. D. (Johns Hopkins Univ., Silver

Spring, Md. (USA). Applied Physics Lab.). Jan 1974. 49p. Dep. NTIS $5.50.

A survey of several explicit numerical methods for calculating the surface temperature of a one dimensional slab subjected to convective heating is presented. The surface conductance and all thermal properties are assumed to be constant. Graphical comparisons of numerical and exact solutions are presented. Some rules of nodal definition based on consistency requirements are established. (auth)

21325 (ANSP-M-8) ORBITAL LIFETIME ESTIMATES. Perini, L. L. (Johns Hopkins Univ., Silver Spring, Md. (USA). Applied Physics Lab.). Feb 1974. 54p. Dep. NTIS $5.75.

Orbital lifetime estimates for long lifetimes (>30 y) are presented for initial eccentricities from 0 to 0.95 and for perigee altitudes from 200 to 1600 km. The lifetime estimates are based on a semianalytic form of the equations of motion developed by King-Hele and the latest (1971) Jacchia atmospheric model. A mean 11 y solar cycle based on historical records of the Zurich sunspot number is employed in the calculations. Comparisons are made to previously published lifetime charts. (auth)

21326 (DPST-74-128-6) SAVANNAH RIVER LABORATORY MONTHLY REPORT: ^{238}Pu FUEL FORM PROCESSES. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). Jun 1974. Contract AT(07-2)-1. 21p. Dep. NTIS $4.25.

LASL has completed the definition of the PPO flowsheet. Shards may be stored up to four months without damage to microstructure by decay helium on subsequent hot pressing. Times for post-hot-pressing heat treatment were shortened. Thermal conductivity of ball-milled $^{238}PuO_2$ has been measured between 200 and 1100°C in air, argon, and helium. Scheduled completion of the Plutonium Experimental Facility may be delayed because of difficulty in obtaining stainless steel sheets. (auth)

21327 (LA-5506-PR) PREPARATION AND EVALUATION OF MEDICAL-GRADE PLUTONIUM-238 FUELS, JULY 1, 1971–JUNE 30, 1973. Mullins, L. J. (comp.). (Los Alamos Scientific Lab., N. Mex. (USA)). May 1974. Contract W-7405-eng-36. 46p. Dep. NTIS $4.00.

Work has continued on the preparation and properties of medical-grade $^{238}Pu^{16}O_2$ fuel forms for the artificial heart program. Procedures were developed for fabricating the 33-W fuel cylinder for the artificial heart vented capsule. Three sources were fabricated and delivered to Mound Laboratory (MRC) for encapsulation in vented capsules. One 50-W and five 29-W non-vented heat sources were fabricated for animal implantation studies. Studies of helium and radon release rates from medical-grade fuel forms have been initiated and are in progress. The characterization of ^{238}Pu fuel forms by nondestructive techniques and chemical analysis has continued. Most of the investigations discussed are of the continuing type. Results and conclusions described may therefore be changed or augmented as the work continues. Published references to results cited in the report should not be made without obtaining explicit permission to do so from the persons in charge of the work. (auth)

21328 (MLM-2166) MOUND LABORATORY ISOTOPIC POWER FUELS PROGRAMS: JANUARY–JUNE 1974. (Mound Lab., Miamisburg, Ohio (USA)). 9 Aug 1974. Contract AT-33-1-GEN-53. 25p. Dep. NTIS $4.00.

Progress is reported on the development of $^{238}PuO_2$ Multi-hundred Watt fuel spheres. (TFD)

Radiation Sources

21329 (AI-65-144) LARGE RADIOISOTOPE HEAT SOURCE STUDY, MID-TERM REPORT TO NEW YORK OPERATIONS OFFICE OF THE ATOMIC ENERGY COMMISSION. (Atomics International Div., Canoga Park, Calif. (USA)). 20 Aug 1965. Contract AT(04-4)-22. 429p. Dep. NTIS $24.50.

Declassified 4 Sep 1973.

The primary objective of this study was the completion of detailed analysis and preliminary design of radioisotope heat sources which can lead to safe, reliable power supplies in the one-to-ten kilowatt electrical range for various unmanned and manned space missions. The work completed by Atomics International up to the Mid-Term Briefing (Aug 10, 1965) is summarized. It reflects the direction being taken on such critical areas as fuel form, capsule materials, and safety. (TFD)

Design and Fabrication

Refer also to abstracts 20821 and 21260.

21330 NEUTRON SPECTRUM STANDARD. Besant, C. B. (to United Kingdom Atomic Energy Authority). US Patent 3,816,742. 11 Jun 1974. Priority date 6 Aug 1971, United Kingdom of Great Britain and Northern Ireland. 4p.

In order to carry out experiments and to make measurements of a fast-neutron flux, it is desirable to have an enclosure, accessible from outside, in which a fast-neutron flux of fairly consistent spectrum can be produced with any convenient irradiation source. The invention provides this apparatus, which comprises concentric inner and outer hollow spheres of, respectively, natural uranium and boron carbide. On irradiation in a thermal flux fast neutrons emanating from the UNAT appear within the inner sphere to the exclusion of thermal neutrons, which are absorbed by the boron carbide sphere. The interior of the latter forms an enclosure in which experiments can be introduced and mounted conveniently on a composite closure plug, which protrudes into the enclosure. (4 figures) (Official Gazette)

21331 PRODUCTION OF SOFT X-RAY SOURCES FROM RADIOACTIVE ^{55}Fe BY AN ELECTROCHEMICAL METHOD. Danilin, L. D.; Pavlova-Verevkina, A. I. Sov. Radiochem. (Engl. Transl.); 15: No. 5, 737-740(1973).

Translated from Radiokhimiya; 15: No. 5, 734-737(1973).

An electrochemical method was developed for preparing x-ray sources based on the radioactive isotope ^{55}Fe, which consisted of depositing Fe from electrolytes containing $FeSO_4$ (10 g/liter on Fe) and Mg as a reducing agent at pH 2.3 to 3.0 with D_c = 6–20 mA/cm^2. The current yield was 50–80%. Several batches of x-ray sources of different configurations with activities from 0.5 to 7.4 Ci were prepared by the method developed. The procedure developed may be recommended for mass production of layers of radioactive iron. (auth)

Industrial Uses

Refer also to abstracts 20582, 21356, 21358, and 21393.

21332 (CNEA-360) RADIOPASTEURIZATION OF MERLUCCIUS, MERCLUCCIUS HUBSI. Mariano, E. E.; Kaupert, N. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1973. 30p. (In Spanish). INIS.

A study was made to specify the optimum irradiation doses in the possible extension of the "Merlucius-Merlucius hubsi" filet storage time at 4°C. Samples from fish caught at different seasons of the year were studied after applying 0.10; 0.20; 0.40; 0.50 and 0.60 Mrad gamma radiation. Trimetilamina levels, volatile reducing substances, volatile acids, and volatile bases were measured from samples taken periodically, the trimetilamina being the most demonstrative for the product's conservation. An "Edibility index" (EL) has been determined to measure with higher precision the edibility limit of this product. In this way it can be stated that the product is edible when its EL remains below 1 ± 0.22 in the irradiated and control samples. The results of this study show that the best dose is 0.5 Mrad. With this dose the storage time for the merluce fillet has been increased fivefold. (auth)

21333 (CNEA-361) TEMPERATURE INFLUENCE ON RADIOPASTEURIZATION OF MERLUCCIUS, MERLUCCIUS HUBSI. Chahin, E. A.; Mariano, E. E. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). Nov 1973. 23p. (In Spanish). INIS.

In order, to obtain a better quality of the "Merluccius, Merluccius hubsi" fillet pasteurized by 0.5 Mrad gamma radiation, the optimum irradiation temperature was studied. The quality evaluation of this product was based on the appreciation of its organoleptic characteristics and the measurement of several volatile components whose formation has a direct bearing on the loss of quality. By the use of a mathematical relation between the values of TMA (trimethylamine), VRS (volatile reducing substances), TVB (total volatile bases), and VAN (volatile acid number) in the irradiated samples and test proofs, the IC (index of conservation) was computed. The results of this study show that the best irradiation conditions are to freeze the samples to –4°C in a short time and to –20°C more slowly. (auth)

21334 CONCRETE-POLYMER COMPOSITE. Araki, K.; Sasaki, T. (Japan Atomic Energy Research Inst., Takasaki). Kogyo Zairyo; 21: No. 9, 28-32(Sep 1973). (In Japanese).

Basic and developmental research was carried out for making concrete-polymer composites (CPC) by the radiation method as one of the applications of radiation curing to industry since 1969. The process includes the steps of drying and vacuum degassing of parent material, impregnating the monomer, packaging and irradiating. The drying is carried out at 150°C for 4 h. Vacuum desiccation is carried out in an enclosed container. The impregnation is performed with methyl methacrylate for 2 to 4 h. The packaging is performed with a polyethylene film or an aluminum foil to prevent volatilization before irradiation. Paraffin coating is very effective. The irradiation is conducted with strong gamma

radiation in an irradiation chamber. The time required to harden the composite of methyl methacrylate with ^{60}Co is 3 hr at a dose rate of 1×10^6 R/h and total dose of 3 MR, or 4 h at 5×10^5 R/h and 2 MR, depending upon the kind of monomer. The CPC manufacturing technique for the surface layer of concrete mortar specimen was carried out using electron beams. Appearance, internal structure, mechanical strength, chemical corrosion resistance and other properties were observed, and good results were obtained. Production cost is estimated to be Y104 per ton of Hume concrete pipe on the basis of 20,000 pieces per month. (JA)

21335 RADIOISOTOPIC DETERMINATION OF MICROSTRESSES IN ALLOYED STEELS. Bochenin, V. I.; Krechmer, V. G. (Karaganda Polytechnic Inst., USSR). Ind. Lab. (USSR) (Engl. Transl.); 40: No. 1, 72-73(Jan 1974).

Translated from Zavod. Lab.; 40: No. 1, 55-57(Jan 1974).

Radioisotopes are now widely used in x-ray structural analysis. The x-ray yield of radioisotopic sources is lower than that of x-ray tubes, but the former are portable, stable, much less expensive, and consume less power. Moreover, some of such emitters provide pure characteristic spectra and are thus very useful in x-ray radiography. A technique for determining stresses of the second kind in heat treated alloyed 44KhGSTF and 37KhGSTF steels using a portable radioisotopic device is described. Monochromatic photons are provided by the cyclotron isotope ^{55}Fe ($T_{\frac{1}{2}}$ = 2.3 yr) which emits the characteristic MN spectrum ($\lambda K\alpha_1$ = 2.098 KX) with a small addition of bremsstrahlung. The ^{55}Fe isotopic source, the sample, and the x-ray film are placed in a chamber 100 mm in dia. X rays from the ^{55}Fe source, in the form of a 20 × 1.5 mm strip with an activity of 70 mCi, pass through a 20 × 0.8 mm slit on the focus circle (R = 50 mm). The rays then strike the investigated sample which rotates in the course of analysis. Diffraction peaks are recorded on x-ray film. To reduce exposure, the described device is covered with a bell-shaped jar and evacuated to 10^{-3} mm Hg. Stresses of the second kind are measured from the width of the (211) ferrite line. (TFD)

21336 POSSIBILITIES OF IDENTIFYING IRRADIATED FOOD. Diehl, J. F. (Bundesforschungsanstalt fuer Lebensmittelfrischhaltung, Karlsruhe (F. R. Germany)). Z. Ernaehrungswiss., Suppl.; No. 16, 111-125(1973). (In German).

11 figs.; 2 tabs.; 48 refs.

The development of reliable methods for the identification of irradiated foods is a basic requirement not only with a view to the official approval of radiation-preserved food by the regulatory authorities, but also for technical reasons, since it must be guaranteed that large-scale, commercial food irradiation can be carried out in such a way and with such methods that there will be no radiation-induced changes in taste, consistency and smell. Furthermore, reliable methods are needed in order to be able to prove the wholesomeness of irradiated food. The known dose-dependent, radiation-induced changes in the main constituents of food, namely proteins, carbohydrates and fats are discussed, and a survey of the hitherto known methods for identifying irradiated foodstuffs presented. Apart from the methods for detecting and characterizing chemical changes in irradiated foods, there are others suitable for identifying physical and structural changes, e.g., E.S.R. measurements, ir spectroscopy, and measurement of electrical conductivity. Moreover, there are plant physiological and biochemical methods which are described here by means of a few practical examples. It has to be said, however, that none of the methods known so far can be considered to be safe and reliable enough to be applied as a routine method in governmental control. Those analytical methods, e.g., those based upon the measurement of radiochemical changes are not suitable for detecting irradiation with a dose < 0.5 mrad—which, on the other hand, can be used as an argument speaking in favor of food irradiation as such. Since the results of long-term animal feeding studies have not revealed any facts speaking against the wholesomeness of irradiated food, a relaxation of the regulations prohibiting food irradiation in general seems to be reasonable and justifiable. (GE)

21337 RADIATION PRESERVATION OF FRUIT JUICE SEMI-CONCENTRATES PREPARED BY CRYOCONCENTRATION. Kiss, I. Acta Aliment.; 2: No. 3, 275-283(1973).

The preservation of strawberry, grape, and apple juices by the combination of cryoconcentration and ionizing radiations was investigated. Fruit juices obtained by conventional methods were clarified with a pectolytic enzyme preparation and then concentrated to various (30 to 50%) solids content by cryoconcentration. Then the products were irradiated with ^{60}Co radioisotope in the exposure range of 0.3 to 1.3 Mrad and stored at 20 to 22°C. During storage the microbiological stability and organoleptic quality of the products were found to be highly dependent on water activity, on the temperature of clarification and on the applied exposure. The keeping quality of a product having 40% solids content was substantially extended with 0.6 Mrad and treatment with 0.8 to 1.3 Mrad ensured practically stable products. The color of semi-concentrates faded as an effect of irradiation. Browning processes occurred during storage which were particularly striking with strawberries. The organoleptic qualities of the 40% concentrates remain unchanged, they retain their original flavor. (Hung. Tech. Abstr.)

21338 EFFECT OF NITRITE ON THE MICROBIOLOGICAL STABILITY OF CANNED VIENNA SAUSAGES PRESERVED BY MILD HEAT TREATMENT OR COMBINATIONS OF HEAT AND IRRADIATION. Farkas, J.; Incze, K. Acta Aliment.; 2: No. 3, 361-376(1973).

The shelf life of Vienna sausages packed in No. ½ cans (ca. 200 g) with brine and heat-treated as 0.25 to 0.55 F_0 was studied as a function of sodium nitrite addition. In uninoculated cans the heat demands of preservation proved to be about 0.3 F_0 in the presence of 300 ppM $NaNO_2$. A heat treatment of 0.55 F_0 and 200 ppM $NaNO_2$ resulted in the higher microbiological stability of cans inoculated with 2×10^4 per tin Clostridium sporogenes spores than a heat treatment of 1.9 F_0 without nitrite addition. The effect of the combination of a 0.35 to 0.55 F_0 heat treatment and 0.45 Mrad of gamma irradiation has also been studied with inoculated cans. The combination of irradiation plus heat resulted in a higher microbiological stability of the samples than the reversed order of treatments but this synergistic effect could not be proved in all tests. The addition of 200 ppM $NaNO_2$ has not been as effective in increasing the shelf life of combination-treated samples as that of the solely heat-treated ones. In a medium composed of a 50% extract of Vienna sausages (6.4 pH, 0.96 a_w) and inoculated with 10^5 Cl. sporogenes spores per ml, 100 ppM or more $NaNO_2$ was required to ensure the microbiological stability of samples heat-treated at 0.4 F_0. In the range of the permissible concentration level for canned meat products, sodium nitrite did not affect the heat resistance of Cl. sporogenes but inhibited germination of the surviving spores. (Hung. Tech. Abstr.)

21339 PRESERVATION OF CANNED VIENNA SAUSAGE BY COMBINATION OF HEAT AND RADIATION. Incze, F.; Farkas, J. Acta Aliment.; 2: No. 2, 173-179(1973).

Since no texture improvers are permitted in Hungarian Vienna sausage, texture and consistency problems arise with this type of product due to the heat treatment necessary for bacteriological safety. Tests have been conducted with the aim of reducing the heat damage by using a combination of mild heat treatment and irradiation. Exposure of 0.45 Mrad have been combined with heat treatments of 0.2 to 0.5 F_0. The F_0 of the control was 1.9. Naturally contaminated samples have been used. Storage temperature was 30°C, storage time up to 2 months. A combination of irradiation (0.45 Mrad) and heat treatment (F_0 = 0.4)—regardless of the sequence—yielded fair results in shelf life and excellent ones in organoleptic properties as compared to traditionally heat-treated samples. This statement is valid for uninoculated samples only. (Hung. Tech. Abstr.)

LIFE SCIENCES

Radiation Effects on Biochemicals

Refer also to abstracts 21336, 21348, 21349, and 21353.

21340 (UCLA-34-P-102-52) ISOTOPIC STUDIES ON STRUCTURE-FUNCTION RELATIONSHIPS OF NUCLEIC ACIDS AND ENZYMES. Progress Report, May 1, 1973–April 15, 1974. Boyer, P. D. (California Univ., Los Angeles (USA). Dept. of Chemistry). 1974. Contract AT(04-3)-34. 7p. Dep. NTIS $4.00.

21341 (UCSD-10-P-20-171) RESEARCH ON THE MARINE FOOD CHAIN. Progress Report, July 1973–June 1974. California Univ., La Jolla, San Diego (USA). Inst. of Marine Resources). 1974. Contract AT(11-1)-GEN-10. 498p. Dep. NTIS $28.00.

Studies on marine food chains and their chemical and physical environments are summarized. Research is reported under the following headings: phytoplankton, zooplankton, microbiology, chemistry, and methodolody and instrumentation. Radioisotope tracer techniques were used in some studies. Research projects that will not be published are described in the first section; reports on completed research that have been or will be submitted for publication are described in the second section; the third section contains narrative accounts of recent cruises where a member of the Food Chain Research Group served as chief scientist. (HLW)

Radiation Effects on Cells

Refer also to abstracts 21349, 21382, 21392, 21496, and 22982.

21342 (BNWL-SA-5027) RADIATION SENSITIVITY DURING THE CELL CYCLE. Roesch, W. C. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 25 Jun 1974. Contract AT(45-1)-1830. 4p. (CONF-740715-4). Dep. NTIS $4.00.

From international radiation research congress meeting, Seattle, Washington, USA (14 Jul 1974).

Chinese hamster cells were synchronized at mitosis and exposed to x radiation. Equations were developed to describe survival factors for each target, and graphs are presented that represent results of fitting the survival curves to the equations. On the basis of experimental data two models of the cell cycle are described and the relation of these to the radiosensitivity of the cell is discussed. The effects of hydroxyurea on cell populations were also studied. (HLW)

21343 ACCELERATION OF AGING IN VITRO BY IONIZING RADIATION. Macieira-Coelho, A.; Lima, L.; Malaise, E. (Institut Gustave-Roussy, Villejuif, France). Z. Alternsforsch.; 27: No. 3, 255-261(1973).

Five groups of cultured fibroblasts from chick embryos were exposed to gamma radiation. Following irradiation the growth curves of the cultures formed a plateau followed by a rapid decline. Increasing doses of radiation resulted in a corresponding decrease in the number of cells. DNA synthesis occurred during the entire life span of the cultured cells. Irradiation caused acceleration of the aging process of the cells. Theories concerning the nature of the aging process are discussed. (HLW)

21344 EFFECTS OF IONIZING RADIATION ON MAMMALIAN CELLS. Cerutti, P. A. (Florida Univ., Gainesville (USA). Dept. of Biochemistry). Naturwissenschaften; 61: No. 2, 51-59(Feb 1974).

4 figs.; 2 tabs.; 129 refs.

Recent progress in the radiobiology of rapidly dividing mammalian cells in culture is discussed. Special emphasis is placed on the lethal, mutagenic, and carcinogenic effects of ionizing radiation. These detrimental effects of ionizing radiation result, for the most part, from damage induced in the nuclear deoxyribonucleic acid (DNA). The formation and repair of radiation-induced breakage of one or both strands of the double stranded DNA helix and of damage to the heterocyclic nucleic acid bases are actively being investigated in mammalian cells. While important progress has recently been made, most of the DNA lesions produced in situ in the cell have not been chemically identified. The relation of the DNA damage to the impairment by ionizing radiation of the cellular functions leading to cell death, mutation, and malignant transformation remains unknown. (GE)

21345 INVESTIGATIONS ON THE CONNECTION BETWEEN RADIATION DOSE, FORMATION OF FREE RADICALS AND INDUCTION OF CHROMOSOMAL ABERRATIONS IN LYMPHOCYTES. Grillmaier, R. E. Ann. Univ. Sarav., Med.; 20: No. 1, 1-89(1973). (In German).

35 figs.; 16 tabs.; 124 refs.

Cultures of human peripheral lymphocytes were carefully frozen and irradiated with x rays at –196°C, then caused to thaw and incubated. The division of the lymphocytes was stopped in the metaphase and the metaphase chromosomes were prepared for the experiment. Part of the samples as well as samples of water and glycerin-free cell suspensions, likewise irradiated at –196°C, were examined by means of ESR spectroscopy for their content of radiation-induced radicals and the behavior of the latter in the temperature range from –177 to –23°C. Irradiation of deep-frozen samples reduces the rate of deletions to $^1/_{15}$ of that of irradiation at room temperature. In contrast to the proportionality between deletion rate and radiation dose observed in samples irradiated at room temperature, the rate of deletions found is more exactly described by a square-law dose response curve. These results seem to indicate that the glycerin penetrating into the cell during freezing causes the chromosomes to grow weak in structure, or to separate into two strands already in the G_1-phase of the cell cycle. Assuming that one single break in one strand of the chromosome, or one break each in both strands will not lead to a chromosomal aberration when there is a sufficiently large distance between the two strand breaks, the splitting of the chromosome filament into two strands is to be considered as the prime cause of the observed reduced radiation effect. Another factor that may contribute to a reduction of the radiation effect is the strong restriction of mobility and reduction of diffusion rate of the molecules and radicals in the frozen substance. This restriction is thought to favor the re-unification of fragments to the original strand. The results of ESR studies suggested that part of the radiolysis products of the water (e^- and H) well most probably react with biomolecules already at 96 to 100°K and cause indirect radiation effects. These ESR studies showed that only OH radicals are present in water at 96 to 100°K and are very rapidly decomposed without formation of bioradicals. The contributions of OH radicals to the total radiation damage can reach a maximum of $^2/_3$ under normal conditions, as shown by these measurements. (GE)

Radiation Effects on Microorganisms

Refer also to abstracts 21336, 21338, 21339, 21358, and 23391.

21346 (NP-20044, pp 117-121) INACTIVATION OF BACTERIAL CELLS BY CHARGED PARTICLES. Matsuyama, A.; Takahashi, T.; Yatagai, F. Dec 1973.

21347 (NP-20044, pp 122-125) LET DEPENDENCE OF DNA-STRAND BREAKS IN E. COLI B_{s-1}. Igarashi, K.; Yatagai, F.; Takahashi, T.; Matsuyama, A. Dec 1973.

21348 OZONE RESISTANCE IN ESCHERICHIA COLI. P. 2. Relations with some DNA Repair Mechanisms. Hamelin, C.; Chung, Y. S. (Montreal Univ., Quebec (Canada). Dept. des Sciences Biologiques). Mol. Gen. Genet.; 129: No. 2, 177-184 (Mar 1974). (In French).

3 figs.; 1 tab.; 22 refs.

Different strains of E. coli commonly used in genetic studies were exposed to ozone and the results indicate that exrA and (lex), but not uvrA genes affect sensitivity to ozone. No relationship between this latter property and the capacity to repair uv-damaged infecting phage (host cell reactivation) was also found. The hypothesis is proposed that the association of ozone sensitivity and x-ray sensitivity in the same mutants may reflect common steps in the mechanism of DNA repair. (auth)

21349 REPAIR OF GAMMA-RAY INDUCED LESIONS IN E. COLI CELLS DEFICIENT IN DNA POLYMERASE I AND HAVING THERMOSENSITIVE DNA POLYMERASE III. Tomilin, N. V. (AN SSSR, Leningrad. Inst. Tsitologii). Mol. Gen. Genet.; 129: No. 2, 97-103(Mar 1974).

4 figs.; 16 refs.

A 2 hr-incubation of gamma-irradiated E. coli polA1 tsdnaE at 45°C prior to plating at 30°C results in the decrease of the fraction of viable bacteria. This effect is not observed in experiments with gamma-sensitive polA1 $dnaE^+$ and gamma-resistant $polA1^+$ tsdnaE bacteria. The uptake of H^3-thymine or H^3-uridine into DNA or RNA of polA1 tsdnaE and polA1 $dnaE^+$ cells shows that the decrease in survival at 45°C in the first strain after gamma-irradiation correlates with the DNA synthesis block rather than with the unspecific inhibition of RNA synthesis. DNA breakdown in gamma-irradiated polA1 tsdnaE cells was found to be higher at 45°C as compared with 30°C.

The results may be interpreted as indicative of the participation of DNA-polymerase III in the repair of gamma-induced lesions possibly during replication. (auth)

21350 GENETIC NATURE OF MUTATIONS IN YEAST INDUCED BY DIFFERENT RADIATIONS AGAINST DIFFERENT GENOTYPIC BACKGROUNDS. Zakharov, I. A.; Gracheva, L. M.; Koval'tsova, S. V.; Kozhina, T. N.; Korolev, V. G. (Inst. of Nuclear Physics, Leningrad). Dokl. Biol. Sci.; 212: No. 1-6, 413-415(1973).

Translated from Dokl. Akad. Nauk SSSR; 212: No. 6, 1445-1447 (Oct 1973).

The nature of mutational changes in DNA is known to be determined by two factors: the character of the primary damage, which is dependent on the mechanism of action of the particular mutagen, and the properties of the processes that develop between the primary mutation and its phenotypic expression. The establishment of a mutation involves repair systems, and genotypic changes affecting the synthesis of repair enzymes may therefore affect the nature of mutations induced in radiosensitive strains with disturbed repair systems. The significance of these two factors was investigated in the yeast Saccharomyces cerevisiae. Mutants were induced by exposure to various ionizing and non-ionizing radiations, uv radiation, x radiation, fission neutrons, and also by the incorporation of $^{32}P\beta$. The effect of radiosensitive mutations blocking various stages in the process of postradiation recovery on the nature of mutations induced by single mutagens was also studied. It was concluded from the results that all the mutagens used induced mutations both of the base-substitution type (behaving in a complementary way) and of other molecular types. The number of complementary mutations was greatest for uv light. The use of ionizing irradiation increased the proportion of noncomplementary mutations, probably arising through the insertion or deletion of nucleotides. Neutron irradiation led to the induction of more profound mutational changes, such as deletions or other chromosome aberrations. The use of fine genetic methods for the analysis of the nature of the induced gene mutations has thus established that the physical mutagens used showed no particular specificity in their mutagenic effects, although there were some significant differences between them. The results of the effect of radiosensitivity mutations on the process of mutation induction showed that the processes of mitotic recombination had a considerable effect on the nature of the mutations which arose. The molecular nature of radiation-induced mutation is thus determined both by the nature of the primary mutational changes in DNA and by the subsequent processes which lead to the establishment of the mutations. (auth)

21351 INFLUENCE OF PRELIMINARY IRRADIATION OF THE NUTRIENT MEDIUM AND INFUSORIA ON THE DIVISION RATE. Kozlov, A. A. (Inst. of Experimental Morphology, Tbilisi, USSR). Soobshch. Akad. Nauk Gruz. SSR; 74: No. 1, 213-215(Apr 1974). (In Russian).

The influence of low dose γ irradiation of infusoria (Colpoda sp.) on the division rate was studied. Preliminary irradiation of the nutrient medium was found to cause an insignificant increase of the average division time of Colpoda. It was noted also that preliminary irradiation of Colpoda did not change the division rate of the following generations. (auth)

21352 PHENOTYPIC PROPERTIES OF BACILLUS SUBTILIS MUTANTS DEFECTIVE IN RECOMBINATION AND REPAIR FUNCTIONS. Samojlenko, I.; Harford, N.; Mergeay, M. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium). Dept. de Radiobiologie). Mol. Gen. Genet.; 130: No. 2, 143-152(May 1974).

5 figs.; 3 tabs.; 21 refs.

Mutants representing four loci (recB, recD, recE, recF) specifying recombination-repair functions in Bacillus subtilis have been characterized in terms of their response in transformation, to transfection by SPP1 or SP50 phage DNA and their sensitivity to X-irradiation. Each of the four mutants is more sensitive to x rays than wild type and shows a reduced ability to transform as measured by the uptake and expression of ^{3}H-labelled DNA. Transfection is reduced in recB and recF strains but the recD and recE mutants appear to retain a high level of transfectability for SP50 phage DNA. The recB and recE mutants retain some capacity for repair of x ray-induced single-strand breaks as judged by alkaline sucrose density gradient analysis. The recF and recD strains show no apparent ability to repair single-strand breaks after irradiation. (auth)

21353 DARK REPAIR OF DNA CONTAINING "SPORE PHOTOPRODUCT" IN BACILLUS SUBTILIS. Munakata, N.; Rupert, C. S. (Texas Univ., Dallas (USA). Inst. for Molecular Biology). Mol. Gen. Genet.; 130: No. 3, 239-250(May 1974).

5 figs.; 1 tab.; 19 refs.

The major thymine-containing photoproduct, 5-thyminyl-5, 6-dihydrothymine or TDHT, in DNA of uv-irradiated bacterial spores is known to be removed during spore germination. In normal Bacillus subtilis this removal is now shown to occur both by excision and by a second, distinct, "spore repair" process, which changes the photoproduct to a harmless form in situ. An energy source for the cells, suppliable by glucose, is required for excision to function at all, and for the "spore repair" process to proceed beyond a limited photoproduct removal. Both repairs can function fully in spores germinated in the presence of 150 μg-ml chloramphenicol or 5 μg-ml rifampincin. The "spore repair" mechanism does not function in vegetative cells when these are transformed by TDHT-containing DNA extracted from irradiated bacterial spores. (auth)

Radiation Effects on Plants

Refer also to abstracts 21168, 21337, and 23388.

21354 ACHIEVEMENTS AND SOME ACTUAL TASKS OF WATER RADIOECOLOGY. Aleksahkin, R. M. pp 7-19 of Radioekologiya Vodnykh Organizmov. II. Raspredelenie i Migratsiya Radionuklidov v Presnovodnykh i Morskikh Biotsenozakh. Andrumaitis, G. P. (ed.). Riga; Izdatel'stvo Zinatne (1973). (In Russian).

The latest achievements in research on problems in radioecology are discussed. Problems concerning migration of natural and artificial radionuclides in aquatic biocenosis and the effect of ionizing radiation on aquatic organisms were investigated. Actual tasks of aquatic radioecology are pointed out. (auth)

21355 SENSITIVITY TO GAMMA RAYS OF DRY LACTUCA SATIVA L. SEEDS, NORTH POLE VARIETY. Corneanu, G.; Slapciu, G. Univ. Craiova, An., Ser. 3; 2: No. 12, 219-226(1970). (In Rumanian).

Dry Lactuca sativa L. seeds of the North Pole variety were germinated directly or 120 days after irradiation with gamma rays (5, 10, 15, 20 and 30 kR). On studying some radiosensitivity tests two growth minima were detected for the radicella and hypocotyll length (10 and 30 kR) in seeds germinated after a period of dormancy. This could be accounted for by the quantity and properties of radicella formed under the effect of different irradiation doses. Other studies involved energy and germinative capacity and chromosomal aberrations; autotetraploid (4x = 36) and autopseudooctoploid cells (8x = 72) were evidenced for the variety exposed to 25 kR. (Rom. Sci. Abstr.)

21356 EFFECTS OF GAMMA-IRRADIATION ON RESPIRATION METABOLISM OF APPLES AFTER PLASTIC COATING. Park, N. P.; Choi, E. H.; Kim, S. C. Korean J. Hort. Sci.; 10: 7-12(1971).

To control the side effects such as a respiratory increase and a tissue disorder by gamma-radiation, plastic film was coated on the surface of apples previous to gamma-irradiation of 100 krad. Effects of single or combined treatments of plastic materials and gamma-radiation on the internal atmospheres, softening and shrivelling of apples during storage were investigated and the results obtained are as follows: Combined treatment groups showed the higher concentration of carbon dioxide and lower concentration of oxygen in inner tissue of Jonathan apples compared with single treatment group of gamma-irradiation. Partial pressure of gas in apple tissues during storage varied with the type of single and combined treatments; the increase and decrease of the partial pressure was more abrupt and sharper in the latter than the former. The appearances of apples stored for 4 months at 10°C and 6 months at 5°C were excellent in the plastic coated groups and the combined treatment groups. Shrivelling and softening caused by irradiation seemed to be controlled by plastic coating prior to gamma-irradiation. (Korean Sci. Abstr.)

21357 INFLUENCE OF FLIGHT FACTORS OF THE ARTIFICIAL EARTH SATELLITE "COSMOS-368" ON THE RADIATION EFFECT IN IRRADIATED LETTUCE SEEDS. Miller, A. T.; Krustyn, A. O.; Shaidorov, Yu. I. (Inst. of Biology, Riga). Latv. PSR Zinat. Akad. Vestis; No. 5, 14-17(1974). (In Russian).

The influence of factors of the cosmic flight of the artificial Earth satellite Cosmos-368 and ionizing irradiation on the growth processes of lettuce, as well as on the changes of the radiation effect of seeds exposed in the satellite after storage in course of a year has been studied. An aftereffect of irradiation effect on vegetating plants has been observed. The factors of the cosmic flight of the artificial Earth satellite Cosmos-368 increased the effectiveness of the radiation in irradiated lettuce seeds, especially when irradiated after the flight (when they had returned back on the Earth). At the same time the storage effect in lettuce seeds under the influence of cosmic flight factors lowers. (auth)

21358 BROWNING OF POTATO TUBERS BY GAMMA RADIATION. III. Influence of Cultural Localities on the Browning of Irradiated Potato Tubers. Tatsumi, Y.; Chachin, K.; Mat-

suzuka, K.; Ogata, K. (Osaka Prefectural Univ., Sakai, Japan). Nippon Shokuhin Kogyo Gakkaishi; 20: No. 4, 132-136(Apr 1973). (In Japanese).

The relation between the browning of potato tubers caused by gamma radiation and cultural localities or the time of irradiation after harvest was investigated, and the change of tyrosine content in irradiated potato tubers was determined. Irish Cobbler potato tubers harvested at seven localities (Kyushu, Shikoku, Kinki, Chubu, Kanto, Tohoku, Hokkaido) were irradiated with doses of 10 and 20 krad 2, 5, and 10 weeks after harvest, and the observation of browning was made on the 7th day after irradiation respectively. When the tubers were irradiated 2 weeks after harvest, the browning showed marked difference among localities. In the tubers harvested in Kinki, Shikoku, and Kyushu, more browning was observed in comparison with those of other localities. The tubers harvested in Kanto showed hardly any browing. When the tubers were irradiated 5 weeks after harvest, the browning was reduced except for the tubers in Kyushu. In the tubers irradiated 10 weeks after harvest when the tubers began to sprout, little browning was observed. It is suggested that the suitable time of irradiation after harvest is about 1.5 to 2 months after harvest. The tyrosine content varied among localities, and the content was increased by irradiation. The increasing rate of the content was greater in irradiated and browned tubers than in irradiated but non-browned tubers. (auth)

Radiation Effects on Animals

Man

Refer also to abstracts 21060, 21064, 22162, 22982, 23275, 23381–23383, and 23387.

21359 (SZS-158) TASKS OF MEDICAL SUPERVISORS OF RADIATION WORKERS. Schuettmann, W.; Arndt, D.; Koenig, W.; Wagner, J. (Staatliche Zentrale fuer Strahlenschutz, Berlin (German Democratic Republic)). Apr 1974. 24p. (In German). Dep. NTIS (US Sales Only) $4.25.

The tasks of medical supervisors of occupationally exposed personnel in the German Democratic Republic are described. On the basis of existing regulations the position of medical supervisors within the framework of radiation protection, supervision is discussed taking into consideration their selection, appointment, and education. The legal situation of occupationally exposed personnel and the responsibility of the authority in charge of an establishment for radiation protection is outlined. Emphasis is given to the specific tasks of the medical supervisor in performing pre-employment and routine medical examination, considering also the diagnosis of health disorders influencing fitness, prescribed examination programs, and exceptional medical surveillance. The medical diagnostic installation of Staatliches Amt für Atomsicherheit und Strahlenschutz is described under the aspect of conception and existing possibilities for examination. Finally the indications for examination in this installation and criteria for the care and transfer of patients are given. (auth)

21360 (SZS-160) STATE AND TENDENCIES OF CHEMICAL PROTECTION AGAINST IONIZING RADIATION. A Literature Survey 1972. Siegel, G.; Tapp, E.; Fischer, H.; Haehn, J.; Diaske, R.; Hannig, H. (Staatliche Zentrale fuer Strahlenschutz, Berlin (German Democratic Republic)). May 1974. 54p. (In German). Dep. NTIS (US Sales Only) $5.75.

Papers published in 1972 in the field of chemical protection against ionizing radiation are reviewed. Protection studies in vitro and in vivo, the biochemical and pharmacological effects of radioprotective agents, and the trends in this field of research are described. (280 references) (auth)

21361 (UR-3490-533) STANDARDS FOR PROTECTION OF PERSONNEL AGAINST NON-IONIZING RADIATION. Michaelson, S. M. (Rochester Univ., N. Y. (USA). Dept. of Radiation Biology and Biophysics). 1974. 49p. (CONF-740509-2). Dep. NTIS $5.50.

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

The biomedical effects of non-ionizing radiations are considered. It was concluded that the present state of knowledge does not permit responsible proposal of standards pertaining to all operating parameters of equipment generating non-ionizing radiations, especially microwaves. Standards should be established for those areas where there exist logical, substantiated conditions for establishing standards. On the other hand, establishment of standards in those areas where our knowledge is lacking would best be postponed. Standards for protection of personnel against uv radiation, lasers, and infrared radiation are presented. (CH)

21362 (USC-113P-53) CLINICAL APPLICATIONS OF MATHEMATICS: CHEMOTHERAPY, RADIOTHERAPY, AND PSYCHOTHERAPY. Technical Report No. RB 73-19. Bellman, R. (University of Southern California, Los Angeles (USA)). May 1973. Contract AT(04-3)-113. 11p. Dep. NTIS $4.00.

The development of computer simulation (Monte Carlo) methods for use in medical decision making in the fields of chemotherapy, radiotherapy, and psychotherapy are discussed. Emphasis is placed on selection of the optimum safe dose of drugs in relation to their side effects; the reduction of the side effects of radiotherapy while delivering the optimum dose distribution regime to neoplasms; and the training of medical personnel in the art of obtaining information relevant to the case history of the patient. (CH)

21363 HALOPERIDOL FOR RADIATION SICKNESS. Control of Associated Nausea, Vomiting, and Anorexia. Cole, D. R.; Duffy, D. F. (New York Univ., NY). N. Y. State J. Med.; 74: No. 9, 1558-1562(Aug 1974).

In a double-blind study haloperidol at an oral dosage of 1 mg twice a day effectively controlled nausea, vomiting, and anorexia resulting from radiation therapy, whereas placebo did not. Results obtained with haloperidol during the two days of double blind treatment of patients were subsequently confirmed during a three-week open evaluation. Haloperidol appears to act promptly, and its effectiveness continues to reduce symptoms over the duration of the course of radiation therapy without producing undesirable side-effects. The results of the study indicate that effective therapeutic doses of haloperidol can be safely administered to initiate and maintain control of nausea, vomiting, and anorexia. (auth)

21364 RADIATION ONCOLOGY: RATIONALE, TECHNIQUE, RESULTS. Moss, W. T.; Brand, W. N.; Battifora, H. St. Louis; C. V. Mosby Company (1973). 629p. $28.50.

The care of cancer patients as individuals each day is discussed. It is pointed out that the administration of ionizing radiations as therapeutic or palliative tools is only a part of the specialty of radiation oncology. The evaluation of patients for irradiation, care during and following irradiation, and follow-up examinations are emphasized. The value of careful diagnosis and of thorough knowledge of the disease in question, the efficacy of alternative methods of treatment, an appreciation of the clinical aspects of radiophysiology and radiobiology, a knowledge of the pertinent physical characteristics of the radiations employed, the value of pre- and postsurgical irradiation for some cases, the selection of the optimum irradiation regime, the combination of radiotherapy and chemotherapy, and methods for reduction of radiation injuries to normal tissues are discussed. The irradiation technique, radiation dose and dose fractionation schedules, types of reactions and side effects in adjacent tissues, and the effectiveness of radiotherapy for various neoplasms are discussed in separate chapters devoted to the anatomical site or tissue under consideration. A separate chapter discusses special problems in the management of childhood cancers. (CH)

21365 OPTIMIZATION OF STANDARD IRRADIATION PLANS BY MEANS OF A COMPUTER. Demonstration of Individual Application by the Example of Irradiation of Mediastinal and Paraaortal Lymph Nodes. Otto, H.; Glaeser, L. (Essen Univ. (Gesamthochschule) (F. R. Germany). Strahlenklinik). Strahlentherapie; 147: No. 2, 166-176(Feb 1974). (In German).

8 figs.; 14 refs.

By the example of irradiation of mediastinal and paraaortal lymph nodes in the course of a system disease, a method is described, which allows optimization of standard irradiation plans by means of a computer. The required data are mailed to the computer center. By variation of the particular parameters dose distributions on standard cross sections can be changed, until they correspond with the requirements as far as possible. An individual dose in complicated moving beam therapy is rendered possible by comparative calculations with a full pendular movement around a central axis. From this a constant factor results, which makes it possible to find out the exposure time necessary for every patient, without further use of the computer, only by using dose tables for fixed fields. This calculation is based on an exact cross-sectional diagram of the patient's body. (auth)

21366 IRRADIATION OF MALIGNOMAS IN THE URINARY BLADDER WITH ULTRAHARD X RAYS OF 43 MV IN THE STATIONARY FIELD. Dimopoulos, J.; Schmidt, W.; Wicke, L. (Vienna Univ. (Austria). Inst. fuer Klinische Strahlenbiologie; Allgemeine Poliklinik, Vienna (Austria). Urologische Abt.). Strahlentherapie; 147: No. 2, 159-165(Feb 1974). (In German).

7 figs.; 1 tab.; 41 refs.

Various plans for stationary-field irradiation of tumors in the urinary bladder using ultrahard x rays from the 43-MeV betatron are demonstrated. According to pathological-anatomical considerations and different ways of tumor propagation, the X-field method proved best in the stages O and A, the Y-method in the stages B and D (with irradiation of two thirds of the dose from

ventral) and the counter-field method in very extensive processes. (auth)

21367 THE RADIOTHERAPY OF LYMPHOGRANULOMATOSIS IN CHILDHOOD. Gyenes, G. (Orszagos Onkologiai Intezet, Budapest (Hungary)). Strahlentherapie; 147: No. 2, 129-138(Feb 1974). (In Germany).

From 54th meeting of the Deutsche Roentgengesellschaft and the 13th meeting of the Oesterreichische Roentgengesellschaft; Vienna, Austria (12 Apr 1973). 13 figs.; 6 tabs.; 22 refs.

Experience gained with 50 children, aged up to 15 years, suffering from Hodgkin's disease, are reported. As 13% of the Hodgkin patients are children, the author advises the pediatricians to take this disease into consideration, if adenopathies do not recede spontaneously or by antiphlogistic and tuberculostatic therapy. By the example of two cases the radiological examination by organ scintigraphy and x-ray contrast lymphography is demonstrated; the dose distribution is shown by isodose curves. (auth)

21368 THE LOCAL AVERAGE NATURAL RADIATION EXPOSURE OF THE POPULATION IN THE FEDERAL REPUBLIC OF GERMANY. Bonka, H. (Technische Hochschule Aachen (F. R. Germany). Lehrstuhl fuer Reaktortechnik). Atomkernenergie; 23: No. 2, 137-150(1974). (In German).

20 figs.; 28 refs.

From measured data on the cosmic and terrestrial radiation exposure of the population in the Federal Republic of Germany, maps about the cosmic, terrestrial, and the total natural radiation exposure are produced. In the measurements done by the "Niedersaechsisches Landesamt fuer Bodenforschung" on the terrestrial radiation exposure, a calibration error is detected. After having corrected the measured values, these now agree with results of other working groups. The average cosmic radiation exposure of the total population should be about 33 mrem/y, the average terrestrial radiation exposure should lie between 50 and 55 mrem/y and the total natural radiation exposure about 104 mrem/y. (auth)

21369 NATURAL RADIATION EXPOSURE. Schraub, A. (Giessen Univ. (F. R. Germany). Inst. fuer Biophysik). Atomkernenergie; 23: No. 2, 127-136(1974). (In German).

10 figs.; 10 tabs.; 10 refs. Also issued as AED-Conf-72-385-032.

A comprehensive survey is given of the progress made during the last twenty years with regard to the measurement and control of radiation components contributing to the "natural" radiation exposure of the population. There are terrestrial and extraterrestrial sources of radiation, and the radiation exposure of man is a result of both "external" and "internal" irradiation, in the latter case due to the incorporation of radioactive substances. Considering the values for the individual radiation components presented on the occasion of a health physics symposium in 1956, the progress made since, due to improved measuring techniques as well as to the better knowledge gained in various fields, especially with a view to cosmic radiation and the incorporation and accumulation of natural radioactive elements in the human body, is demonstrated. Part of the data given in 1956 had to be corrected, and further elements of the U-Ra series and radium-228 of the thorium group had to be included in the table. The significantly larger amount of measured data obtained all over the world allows a far deeper insight into the relevant material, such as mean global values, statistical straggling and occasional extreme values. (auth)

21370 DUTY OF THE PHYSICIAN TO INFORM PATIENTS ABOUT POSSIBLE RADIATION RISKS AND TO PERFORM X-RAY TREATMENT WITH DUE CARE. Rieger, H. J. Dtsch. Med. Wochenschr.; 99: No. 3, 108-110(Jan 1974). (In German).

In its decision of Sept. 6, 1973 (2 U 159/72), the OLG Braunschweig (provincial court of appeal) sentenced a physician to pay damages and smart money for injuries received for not having informed his patient about the possible radiation risk and for having applied an overdose of x radiation. The patient who suffered from Diabetes mellitus consulted the physician for a wart on the left lower leg which had been removed by the physician by means of electrocautery. The histological examination of the wart tissue revealed a precancerous stage; the affected skin area has been treated by the physician with a fractionated (500 R) irradiation up to a total dose of 5,000 R. This led to a tertiary radiation damage of the skin (roentgen ulcer), the patient first had difficulties in walking and finally became incapable of working. (GE)

21371 INTERACTIONS BETWEEN THE UV AND X-RAY ERYTHEMA OF HUMAN SKIN. Hakemi, N. Heidelberg; F. R. Germany; Univ. Heidelberg (1972). 31p. (In German). INIS.

5 tabs.; 16 refs. with abstract. Available from the library of the Heidelberg Univ.

The interaction between uv and x-ray erythema on the human skin was studied on 60 light-skinned volunteers. First, the effect on the minimum erythema dose (MED) after exposure to x-radiation at 50 to 300 R was determined immediately after irradiation and at certain intervals up to 24 h post-irradiation. The lateral hip region of 40 persons was irradiated for this purpose. The results did not reveal a clear dependence of MED on this pre-irradiation. In the second part of the study, 20 patients whose skin had been irradiated with x-ray doses between 200 and 3,800 R for therapeutical purposes one to five years prior to this experiment were examined for determining the MED on the irradiated parts of the skin and the results were then compared with the data obtained on non-irradiated skin of the same patients. X-ray pre-irradiation with 720 R was found to have no effect on the MED, whereas pre-irradiation with 750 R and more clearly resulted in an increase of the MED. (GE)

21372 IS THERE AN INCREASED CANCER RISK IN THE VICINITY OF NUCLEAR POWER PLANTS? Naturwiss. Rundsch.; 27: No. 4, 154-155(Apr 1974). (In German).

Sixteen years after the commissioning of the first commercial nuclear power plant in Shippingport, USA, the Governor of Pennsylvania has set up a committee in order to investigate whether the operation of this nuclear installation does in fact present a hazard to the population living in the vicinity of the plant. Some data compiled by Sternglass are presented which seem to support this view. Furthermore, some associations and committees appointed in Europe to carry out similar studies are mentioned. (GE)

21373 XERORADIOGRAPHY IN A RADIATION THERAPY DEPARTMENT. Fingerhut, A. G.; Fountinelle, P. M. (Western Tumor Medical Group, Van Nuys, CA). Cancer; 34: No. 1, 78-90(Jul 1974).

From 15th annual meeting of the American Society of Therapeutic Radiologists; New Orleans, LA (24 Oct 1973).

The use of xeroradiography in a radiation therapy department for field verification is described. The technique developed and its advantages are presented, together with examples of typical field verification xeroradiograms. (auth)

21374 THYROID DISEASE IN CHILDREN. A Survey of Subjects Potentially Exposed to Fallout Radiation. Rallison, M. L. (Univ. of Utah, Salt Lake City); Dobyns, B. M.; Keating, F. R.; Rall, J. E.; Tyler, F. H. Arch. Tech. Mes.; 56: 457-463(Apr 1974).

No significant difference was found in any type of thyroid disease between children in Utah and Nevada exposed to fallout radiation in the 1950's and control groups living in Utah and Arizona at present. Of the 5,179 children surveyed, thyroid abnormalities were found in 201. Adolescent goiter was the most common disorder with a prevalence of 15 per 1,000 for boys and 20 per 1,000 for girls. There were seven cases of hyperthyroidism, and the rates for lymphocytic thyroiditis were 8 and 16 per 1,000 for boys and girls, respectively. Twenty benign neoplasms and two carcinomas of the thyroid were found. Only 6 of the 201 children with thyroid disease knew of their disease prior to our examination. The inapparent thyroid disease discovered in this group of children through meticulous examination may have its counterpart in other populations as well. This study demonstrates the need, therefore, for careful examination of thyroids even in apparently healthy children. (auth)

21375 AUTOMATION OF DOSIMETRY IN BRACHYTHERAPY. Mexico City; Miguel Angel Valdovinos Teran (1973). 68p. (In Spanish).

Thesis.

Physical and radiobiological aspects of the interaction of electromagnetic radiation with matter are briefly reviewed. The computer program used to make the dosimetric calculations is outlined in detail. The results obtained in calculating isodose distribution curves are reported. (JSR)

21376 RADIATION-INDUCED CANCER OF THE THORACIC ESOPHAGUS. Asakawa, H.; Otawa, H.; Watarai, J. (Miyagi Prefectural Adult Disease Center, Natori, Japan). Gan No Rinsho; 20: No. 5, 413-416(May 1974). (In Japanese).

In 1929, at the age of 22, the patient was given x-ray therapy for tuberculosis of the hilar node and 4 years from 1930 to 1933, for caries of the thoracic and lumbar spine. The irradiated dose at the esophagus was estimated at about 2700 rads. She had marked post-radiation change in the skin over her back and lumbar region. Roentgenologic and endoscopic examination revealed a carcinoma of the thoracic esophagus which on endoscopic biopsy was shown to be a squamous cell carcinoma. (auth)

21377 RELATIVE LOWERING OF RECTUM DOSE DURING THERAPY OF CARCINOMA OF THE UTERINE CERVIX BY THE USE OF ^{137}Cs IMPLANTS WITH DEFORMED ISODOSE DISTRI-

BUTION. Grossmann, H. Radiobiol.-Radiother.; 15: No. 2, 291-293(1974). (In German).

Comparative measurements of the relative radiation dose by ^{137}Cs portio plates without and with deformed isodose run (achieved by heavy-metal shields) were carried out in the rectum. The maximum desired dose reduction to the rectum by these plates is about 50%. The relative dose reduction actually found with 276 implants was on the average 33%. Thus the use of ^{137}Cs portio plates with deformed isodose run can be recommended, either in order to avoid some radiation damage or, if it is necessary, in order to increase the therapeutically usable dose. (auth)

21378 SYMPTOMATIC ZOSTER IN PATIENTS WITH HODGKIN'S DISEASE TREATED AT DEPARTMENT OF RADIOTHERAPEUTICS, MEDICAL ACADEMY IN THE YEARS 1960-1971. Kukolewska-Machnicka, J. (Inst. of Radiology, Warsaw). Pol. Przegl. Radiol. Med. Nukl.; 38: No. 2, 205-210(1974). (In Polish).

In the years 1960 to 1971, 124 patients with Hodgkin's disease were treated at the Department of Radiotherapeutics in Warsaw. In 20 of these patients zoster developed (16%). In most cases (16) Hodgkin's disease was significantly advanced and the general resistance of the organism was low at the time of appearance of zoster. A correlation between zoster and radiotherapy was observed in 18 patients, in 12 of them it developed from 1 to 7 months after completion of radiotherapy. Five patients died within one year after radiotherapy from reduced resistance of the organism and exacerbations of Hodgkin's disease after zoster. (auth)

21379 EXPOSURE OF HUMAN GONADS TO X-RAY DOSE AND CONDITIONS INFLUENCING THE VALUE OF THE DOSE DURING ROUTINE RADIOLOGICAL DIAGNOSIS. Majle, T.; Rozycki, Z. (Zaklad Ochrony Radiologicznej i Radiobiologii Panstwowego Zakladu Higieny, Warsaw). Pol. Przegl. Radiol. Med. Nukl.; 38: No. 2, 211-222(1974). (In Polish).

Using a human-body phantom and a Victoreen dosimeter measurements were made of doses to the gonads of patients during selected, typical radiological examinations involving the area of gonads. The obtained results permitted value of the doses and the conditions influencing this value to be estimated. The order of values of the doses to gonads on a single examination approaches the annual dose of natural radiation. A high relationship was found between these doses and the radiological equipment used, the method of examination and the observation of the principles of radiological protection of the patient. (auth)

21380 KINETICS OF CELL PROLIFERATION IN TUMORS. Blomqvist, K. (Radiotherapy Clinic, Helsinki). Magy. Radiol.; 26: No. 3, 163-172(Jun 1974). (In Hungarian).

The growth rate of tumors depends in part on the proportion and on the cell cycle distribution of proliferating cells and in part on the rate and extent of cell loss. The difference in cell cycle durations between normal and malignant tissues and between different experimental and human tumor types is relatively small. It cannot explain the wide range of tumor doubling times, which seems largely to be due to differences in the proportions of proliferating cells (growth fraction) and rates of cell loss. Irradiation or cytotoxic drugs produce a disturbance on the kinetics of tumor cell proliferation. Radiation will reduce or temporarily stop cell division, while the normal processes of cell loss continue. An acceleration of growth rate of surviving tumor cells was observed both in man and in experimental animals. The growth rate in the recovery phase after irradiation is also found to vary considerably with tumor type. Changes in growth fraction, cell loss, and intermitotic time all probably play some part in determining changes in growth rate during the repopulation process. (auth)

Vertebrates

Refer also to abstracts 21170, 21354, and 21410.

21381 (CONF-740715-6) USE OF CHROMOSOME ABERRATIONS FOR PREDICTING GENETIC HAZARDS TO MAN. Brewen, J. G.; Preston, R. J. (Oak Ridge National Lab., Tenn. (USA)). 1974. 25p. Dep. NTIS $4.25.

From international radiation research congress meeting; Seattle, Washington, USA (14 Jul 1974).

A review of the literature on radioinduced genetic damage is presented. Some topics discussed are: interspecific comparisons of radioinduced dicentrics and deletions in peripheral leukocytes; comparison of dicentric yields in leukocytes to reciprocal translocation yields in spermatogonia; recovery of spermatogonia induced translocations in the sons of irradiated males; and chromosome deletions induced in human and mouse leukocytes by x radiation. (HLW)

21382 (SAN-410-173) BASIC STUDIES OF THE IMMUNE RESPONSE AND THE EFFECTS OF RADIATION ON THE RESPONSE. Progress Report, July 1, 1973-June 30, 1974. Dixon, F. J. (Scripps Clinic and Research Foundation, La Jolla, Calif. (USA). Dept. of Experimental Pathology). 28 Jun 1974. Contract AT(04-3)-410. 10p. Dep. NTIS $4.00.

During the past year studies on the nature of the cells necessary to reconstitute the immune competence of lethally irradiated mice were continued. Such reconstitution experiments were used to study the cellular events in the induction of immunological unresponsiveness. This approach was extended to include studies designed to determine what cells are required to permit the induction of autoimmune thyroiditis in lethally irradiated mice. Other studies were concerned with the effect of irradiation on the immune response. The direct effect of in vitro irradiation on the immunocompetence of T cells was investigated. In addition, the effect of irradiation and chemical immunosuppression on chronic viral infections was determined. Studies on the effect of irradiation on the immune response in mice were continued. (auth)

21383 (UCD-34P187X2) HEMATOPOIETIC REPOPULATION FOLLOWING IRRADIATION INJURY. Progress Report, September 1, 1973-June 1, 1974. Lewis, J. P.; O'Grady, L. F. (California Univ., Davis (USA)). 1974. Contract AT(04-3)-34. 29p. Dep. NTIS $4.50.

Progress is reported on the following research projects: hematopoietic injury and recovery in mouse cells exposed to various doses of x radiation; studies on erythropoietin in x-irradiated mice; effects of x radiation on urinary granulocyte stimulating factor in mice; effects of x radiation on serum thrombopoietin in mice; effects of infusions of granulocytes, platelets, and subcellular fractions in blocking hematopoiesis; and assay of the effects of chalone using methylcellulose cultures for granulocyte progenitors. (HLW)

21384 (UR-3490-583) CALCULATION OF THE RADIATION DOSE TO THE TRABECULAR SECTION OF A RAT FEMUR. Yalcintas, M. G. (Rochester Univ., N. Y. (USA). Dept. of Radiation Biology and Biophysics). 1974. 154p. Dep. NTIS $10.75.

Thesis.

The size of the cavities in trabecular and shaft marrow of the rat femur were determined utilizing Zeiss size analyzer, and the distribution curves were obtained. The degree of filling of these spaces with radioinsensitive circulating blood in the sinusoids was estimated. The theoretical average doses to hematopoietic tissues in these cavities were calculated with or without considering the sinusoidal blood volume and blood vessels in bone marrow. The effects of various doses on the uptake of ^{59}Fe in the hematopoietic system has been determined for three different x-ray energies (80 kVp, 150 kVp, 1000 kVp) and it was shown that the effects of x irradiation for the dose on the marrow may differ with the different methods of dose determinations with or without taking into account the sinusoidal blood volume and blood vessels in bone marrow. (auth)

21385 INVESTIGATION OF THE LATENCY PERIOD OF THE GALACTOSE CATARACT OF RATS AS A FUNCTION OF THE BEGINNING OF A GALACTOSE DIET AND TRUNK OR WHOLE-BODY IRRADIATION WITH X RAYS. Ninnemann, U. Bonn, Ger.; Bonn Univ. (1972). 45p. INIS. (In German).

2 figs.; 4 tabs.; 83 refs. With abstract. Available from the library of Bonn Univ.

Diss. (M.D.).

Young rats were used as experimental animals and the beginning of irradiation and the diet were varied. The latency period up to the occurrence of a 50% cataract served as reference. Trunk irradiation contributed to the formation of a galactose cataract and this process was clearly dependent on the time of irradiation. The shortening of the latency period due to irradiation became more obvious the earlier the animals were irradiated. Assuming the resorption to be equal in all cases, this shortening of the latency period may be the result of changes in the pathway of galactose catabolism, or of the formation of toxic substances, with the latter contributing to the occurrence of a cataract in addition to the effect of the noxa galactose. Earlier findings on the formation of a galactose cataract after whole-body irradiation were confirmed. In animals of 6-8 weeks put on a galactose diet immediately after irradiation, prolongation of the latency period was found in terms of an "artificial aging". A comparison with the results obtained after trunk irradiation showed that only direct x-ray irradiation of the lens results in artificial aging, and that this process is restricted to a certain age of the animals. With increasing age of animals and time elapsed since irradiation, this effect is reversed to a shortening of the latency period, although this effect is not as marked as the shortening in trunk irradiated animals. This change is to be classified as belonging to the group of addition cataracts. (GE)

21386 PROTECTIVE EFFECT OF AN ELEMENTAL DIET ON RADIATION ENTEROPATHY IN THE MOUSE. Hugon, J. S.; Bounous, G. (Sherbrooke Univ., Quebec (Canada). Dept. of Pathology; Sherbrooke Univ., Quebec (Canada). Dept. of General Surgery). Strahlentherapie; 146: No. 6, 701-712(Dec 1973).

13 figs.; 2 tabs.; 34 refs.

An elemental diet containing 9.5% protein hydrolysate instead of whole proteins was shown to improve the 30 days survival in mice following 900 rd of gamma rays. Survival rate and body-weight of different groups of animals receiving diets with 9.5% or 15% protein hydrolysate or whole proteins, given before and after irradiation or only after irradiation, were compared. Intestinal mitotic indices in mice eating the same diets were also measured following 1,000 R of gamma rays. The results show that an elemental diet containing 9.5% protein hydrolysate appears to provide the best survival rate, weight recovery, and intestinal mitotic index on condition that the diet is given before irradiation. Some of the reasons explaining this positive effect of the elemental diet are discussed. (auth)

21387 HERITABLE DAMAGE FOLLOWING PRENATAL FRACTIONATED X-IRRADIATION IN RATS. Baev, I.; Bairakova, D.; Benova, D. (Nauchno-Izsledovatelski Inst. po Radiologiya i Radiatsionna Khigiena, Sofia (Bulgaria)). Strahlentherapie; 146: No. 6, 734-737(Dec 1973).

4 tabs.; 11 refs.

Fertility, female reproductivity, and dominant lethal mutation rates in males were studied in rats exposed in utero to fractionated 800 R x rays (40 R × 20 days). Cysteamine or cystamine protection ensured development in due time and survival to maturity of 20 females and 24 males, 50% exhibiting absolute sterility, reduced reproductive performance, and increased frequency of dominant lethal mutations. (auth)

21388 HEMODYNAMIC CHANGES PRODUCED BY CONTINUOUS WHOLE-BODY X IRRADIATION IN RABBITS. Nadareishvili, K. Sh.; Sharashenidze, N. B.; Dzhandzhgava, M. M. (Inst. of Physiology, Tbilisi, USSR). Soobshch. Akad. Nauk Gruz. SSR; 74: No. 1, 177-180(Apr 1974). (In Russian).

The changes in the arterial and venous blood pressures, minute volume and other hemodynamic indices resulting from whole-body x-irradiation were studied in rabbits immobilized with procurane or tubarine and maintained on artificial respiration. It was demonstrated that the early phase of hypotension was due to a sharp decrease in common peripheral resistance of the blood vessels. In this period a significant increase of minute volume was observed as a compensatory reaction. However, when the irradiation dose was as high as 20 to 25 krads, the second irreversible phase of hypotension developed. The mechanism of the origin of this phase was obscure. (auth)

21389 PRINCIPAL HEMODYNAMIC CHANGES DURING CONTINUOUS HEAD-IRRADIATION IN RABBITS. Sharashenidze, N. B.; Nadareishvili, K. Sh.; Saneblidze, O. I. (Inst. of Physiology, Tbilisi, USSR). Soobshch. Akad. Nauk Gruz. SSR; 74: No. 1, 181-184(Apr 1974). (In Russian).

As distinguished from whole-body x irradiation, in similar experimental conditions, hemodynamic changes are not well-pronounced during a local exposure of the head before the terminal condition develops. Even the absorbed doses that cause irreversible phase of hypotension and other symptoms of irradiation shock in case of a total-body irradiation result in no conspicuous hemodynamic changes. Systemic arterial pressure is altered in terms of and parallel to the minute volume and common peripheral resistance of the blood vessels, while in case of total-body irradiation they alter in the opposite direction. When the absorbed dose of head irradiation is 10 to 30 krads, the arterial pressure is markedly increased. It is suggested that the effect is due to the development of brain hypoxia and it may be a maximal compensatory reaction of the organism. It is not ruled out that brain edema and intracranial pressure changes play a certain part in this effect. (auth)

21390 RADIOPROTECTIVE ACTION MECHANISMS OF DIMETHYL SULPHOXIDE. Goncharenko, E. N.; Burlakova, E. V.; Zhat'kova, G. S.; Samoylikova, T. I.; Dzhanumova, T. G. (Moscow Mining Inst.). Biol. Nauki; No. 12, 45-47(1973). (In Russian).

The effect of dimethyl sulphoxide on some endogenic material participating in the creation of a biochemical background of increased radioresistance in mammals was studied. It was shown that the radioprophylactic effect produced by the introduction of dimethyl sulphoxide is accompanied by an increase in the concentration of endogenic radioprotective agents (serotonin, histamine, and dopamine) and a decrease of the activity of biogenic radiosensitizers of a lipid nature in a number of tissues. The changes observed coincide with those detected during the action of other classes of chemical radioprotective agents and quantitatively suggest the effect caused by preparations with an average protective capacity. (tr-auth)

21391 EXPERIMENTAL TREATMENT OF PIGS IRRADIATED ON THE ABDOMEN WITH SUPRALETHAL DOSES. Daburon, F.; Chomette, C.; Garnier, H.; Remy, J.; Villiers, P. A.; Nizza, P. (CEA, 78-Jouy-en-Josas (France). Lab. Etable de Radiobiologie Appliquee). Strahlentherapie; 146: No. 6, 718-733(Dec 1973).

4 figs.; 4 tabs.; 13 refs.

Twelve pigs were irradiated with doses ranging from 1,250 to 1,750 rd under simultaneous protection of the bone marrow (neck and shoulder region); the protection was strong enough to avoid death by the haematologic syndrome. In seven pigs, irradiated with 1,250 rd under the same protection, a cross-transplantation of the jejunum and the ileum was carried out with a littermate compatible for SL-A system. All animals received general treatment (parenteral feeding, antibiotics) as well as local gastrointestinal therapy. Symptomatology and survival time are discussed under consideration of the different experimental conditions and also with regard to the histological lesions of the digestive tract. (auth)

21392 THE INFLUENCE OF OZONE ON TUMOR GROWTH AND RADIATION EFFECTS. Experiments with the Transplantable Chondrosarcoma and C3H Tumor. Badenberg, B. Essen, Ger.; F. R. Germany; Essen Univ. (1972). 47p. (In German).

4 figs.; 8 tabs.; 79 refs. With abstract. Available from the library of the Essen Univ.

The action of i.p. injected ozone on the tumor growth and the effect of x radiation were examined on transplantable chondrosarcoma, Ehrlich carcinoma, and C3H tumor in female mice of 20 to 26 g body weight. Furthermore, the influence of unsaturated fatty acids on tumor growth and the effect of x radiation and ozone were investigated. Previous experiments showed that single doses of i.p. injected 39 γ ozone/g body weight are well tolerated by the mice. The oil diet fed during the experiments contained 10% thistle oil, consisting of 75% linolic acid and 12% oleic acid, and experiments showed that this diet, too, is well tolerated. The tumors were transplanted into 16 groups of mice. Eight of these were fed daily with the oil diet, the remaining eight groups were maintained on a normal diet. Thus there were eight group pairs of differently fed experimental animals. Ozone treatment started on the first day of the experiment and was continued daily throughout the experiment. The first group pair received no ozone at all, the second 0.007, the third 0.07, and the fourth 0.7 γ ozone/g. The remaining four group pairs received an additional partial body irradiation of the tumor-carrying extremities with a dose of 100 R x-radiation on the 2nd day of the experiment. The animals were sacrificed for determination of the tumor weight when the tumor weight of the control group was about 1 g. A comparison of tumor weights showed the following results: The inhibiting effect of the x radiation was highly significant in all cases. Inhibition of tumor growth by the oil diet could not be stated. The same applies to ozone and x-ray treatment, which have not been affected by the oil diet. Only the lowest dose of ozone showed an effect on the C3H tumor, and only in combination with x radiation, whereas the effect of ozone on the chondrosarcoma was manifest independent of the dosage. Combined with x radiation, only the two higher ozone concentrations showed an inhibiting influence. As ozone affects predominantly the membrane of the tumor cell, the different efficiency of ozone with regard to the chondrosarcoma and the C3H tumor might be due to the different properties of the membranes. This has to be clarified in future experiments. (GE)

21393 STUDIES ON THE WHOLESOMENESS OF GAMMA-IRRADIATED RICE. II. On the Weight Gain, Reproduction Ratio, Mortality, and Growth Rate After Weaning of Mice. Kim, S. K.; Lee, K. Y.; Lee, S. R. Han'guk Sikp'um Kwahakhoe Chi; 5: No. 3, 149-152(1973).

As the third-year experiment on the wholesomeness of irradiated rice with 50 and 100 krad gamma rays, a feeding test was undertaken with mice of F_2-generation which were used in the preceding year. No significant difference was observed between the irradiated group and control group with respect to gain of body weight, reproductive ratio, mortality, and average body weight of weaning mice. (Korean Sci. Abstr.)

21394 EFFECT OF IODINE-131 ADMINISTRATION ON OVARY, UTERUS, AND SEXUAL CYCLE OF GUINEA PIG. Lee, K. W.; Yoon, H. J.; Lee, K. S. Korean J. Anim. Sci.; 15: No. 2, 155-161(1973).

The effects of radioiodine (^{131}I) administration on the histology of ovary and uterus and sexual cycle of the mature guinea pigs were observed. A single dose of 4.5 mC radioiodine per kg body weight was injected subcutaneously. On the 1, 7, 14, 28, 42 and 56th day after radioiodine treatment, five treated and 5 control guinea pigs were sacrificed and their ovary and uterus were examined histo-

logically. The variations in sexual cycle were examined by vaginal smear method through the experimental period. The results obtained were as follows: No histological changes in the ovary were observed on the first day after treatment. On the 7th day after treatment, however, some atretic follicles were appearing and granulosa cells were changed with pyknosis and karyorrhexis. From the 14th day onwards, primordial follicles began to be damaged. After 42 days atretic follicles and atrophy or hypoplasia of interstitial cells were observed. On the 56th day after treatment, these ovaries began to be restored to the normal state. The atrophy of myofibrils and multiplications of interstitial connective tissue of tunica muscluaris were observed in the uterus after treatment. The change in sexual cycle of the treated guinea pig was apparent. The diestrus period extended in some guinea pigs to the 10th day after treatment. From the 21st day onwards, the distinct extension of diestrus period was observed. (Korean Sci. Abstr.)

21395 ADSORPTION OF RADIOVITAMIN B_{12} IN MICE AFTER SPECIFIC IRRADIATION OF THE STOMACH. Salmi, H. A.; Salmi, T. T.; Lindgren, I. (Univ. of Turku, Finland). Ann. Med. Exp. Biol. Fenn. (Helsinki); 51: No. 4, 151-154(1973).

The adsorption of vitamin B_{12} after local selective in situ irradiation of the stomach was studied in mice. After four weeks the absorption was examined by administering ^{57}Co B_{12} in physiological doses using a tube inserted via the oesophagus into the stomach, and measuring the radioactivity of liver, kidneys, heart and spleen. Radiation impaired absorption to an extent correlated with the total radiation dose. The histological picture showed general nuclear damage and a general disturbance of the formation of mucopolysaccharides. The probable pathomechanism of the observed impairment of the absorption is a decrease in gastric intrinsic factor secretion. This decrease seemed to occur with radiation doses which did not cause any morphologically demonstrable changes. (auth)

21396 ROLE OF IMMUNITY IN RADIATION LEUKEMOGENESIS. Haran-Ghera, N. (Weizmann Inst. of Science, Rehovoth, Israel). Bibl. Haematol.; No. 39, 671-676(1973).

The susceptibility of C57BL/6 mice to radiation leukemogenesis is age-dependent, the leukemia incidence decreasing with age increase. The thymus architecture did not seem to be responsible for this decrease in tumor incidence. Since the leukemogenic virus is present in normal C57BL/6 mice, it is proposed that natural immunization occurs in older mice, and thereby reduces the susceptibility to radiation leukemogenesis with age increase. (auth)

21397 TOLERANCE INDUCTION TO A HETEROTOPIC CARDIAC ALLOGRAFT IN THE IRRADIATED RECONSTITUTED MOUSE. Jirsch, D. W.; Kraft, N.; Diener, E. (Univ. of Alberta, Edmonton). Transplantation; 18: No. 2, 155-162(Aug 1974).

With use of a variety of techniques, specific functional tolerance can be produced in adult mice across a strong histocompatibility barrier with a heart allograft model. Spleen cells from tolerant animals can express graft-directed killer cell activity in vitro (but apparently not in vivo) and can transfer tolerance to a second recipient. The nature of this inhibition in vivo remains obscure. Serum blocking factors have not yet been identified in the sera of tolerant mice. (auth)

21398 THYMIDINE AND DESOXYURIDINE EXCRETION IN IRRADIATED HAMSTERS: ADMINISTRATION OF EXOGENOUS DNA. Mikhailov, V. F. (Inst. of Biophysics, Moscow). Byull. Eksp. Biol. Med.; 77: No. 6, 48-51(Jun 1974). (In Russian).

Hyperexcretion of thymidine and desoxyuridine was revealed in the urine of hamsters during the first 24 hours after their irradiation in doses of 600, 700, and 1000R. An increase in the urinary excretion of nucleosides followed the irradiation (700 R) on the 1st, 8th to 10th, and 25th days. Administration of DNA to hamsters one hour after the irradiation (1000 R) produced a reduction in the nucleoside level in the course of the first 24 hours. (auth)

21399 INCREASED SOLUBILIZATION OF THYMUS AND SPLEEN CHROMATIN FROM IRRADIATED MICE BY LOW DEOXYCHOLATE CONCENTRATIONS. Skalka, M. (Inst. of Biophysics, Brno). Folia Biol. (Prague); 20: No. 3, 205-215(1974).

Introductory experiments with a suspension of calf-thymus chromatin and suspension of reconstituted nucleohistone have shown that even very low (<5 mM) deoxycholate concentrations cause their solubilization in 0.14M NaCl solution. In the presence of similar low deoxycholate concentrations calf-thymus deoxyribonucleoprotein prepared in a solution of low-ionic strength became unprecipitable in 0.14M NaCl solution. In this paper attention has been paid mainly to the deoxycholate-induced changes in the solubilization behavior of thymus and spleen chromatin or irradiated mice. The chromatin from these tissues of irradiated mice (6 hours after 600R) was found to be more sensitive to the effect of low deoxycholate concentrations than the chromatin isolated from the thymuses and spleens of normal mice. No difference was found, on the other hand, between normal and irradiated mice in the sensitivity of their liver and kidney chromatin to deoxycholate. The solubilization of thymus and spleen chromatin in 1.5 mM deoxycholate-0.14M NaCl solution was shown to be enhanced over a long interval from 4 to 16 hours after whole-body irradiation. The response of thymus chromatin is higher and of longer duration than that of spleen chromatin. The solubilization of thymus and spleen chromatin in deoxycholate solution, studied at 6 and 16 post-irradiation hours, increases with whole-body exposure over the whole dose-range used (0 to 600R). This character of dose-effect relation of the solubilization behavior is thus different from the earlier described manifestations of postirradiation damage to chromatin, i.e. release of polydeoxyribonucleotides and increased sensitivity of chromatin to the action of polyanions. (auth)

21400 BEHAVIOR OF IRRADIATED OVARIES AFTER INTRASPLENIC TRANSPLANTATION IN CASTRATED RATS. Matsumoto, A. (Tokyo Univ.). Annot. Zool. Jap.; 46: No. 3, 165-172(Sep 1973).

Ten-day-old female rats were exposed to about 190 R of x rays. Their ovaries 0.5, 1, 3, 6, 24 hours or 30 days after irradiation were transplanted into the spleen of castrated male rats at 4 months of age. Normal oocytes in the ovaries of irradiated females markedly decreased in number during a post-irradiation period of 24 hours, only 1.6% of them being left intact. However, if the ovaries were transplanted into the spleen of castrated rats within 24 hours after irradiation, the grafts were developed into masses of corpora lutea, like grafts of non-irradiated ovaries. There was no significant difference in weight between the two kinds of grafts. By contrast, ovaries containing a few normal oocytes at 30 days after irradiation rarely took root after transplantation and successful grafts exhibited only a few regressing corpora lutea but neither healthy-appearing corpora lutea nor follicles. (auth)

21401 BIOLOGICAL EFFECTIVENESS OF THE COMBINED X-RADIATION AND CYCLOPHOSPHAMIDE IN RATS: DEPENDENCE OF DOSAGE, FRACTIONATION, AND THE TIME SEQUENCE OF THE COMBINATION. Schmidt, W. (Medizinische Akademie, Magdeburg, Ger.). Radiobiol.-Radiother.; 15: No. 2, 295-302(1974). (In German).

In examinations of 360 white rats the question was considered in what way the biological effects in combined influence of whole-body x irradiation and cyclophosphamide in dependence on dosage, fractionation, and time sequence of the measures are reflected by the hematological reaction course and by the survival rate and how they are combined. The results may be summarized as follows. The values of LD 50 obtained for whole-body x irradiation and cyclophosphamide are 710 R/O and 133 mg/kg body weight cyclophosphamide, LD 5 values are 610 R/O and 66 mg/kg cyclophosphamide. After irradiation, leukocytes react more rapidly and the lowest values are reached earlier than after cyclophosphamide application. On the other hand, regeneration is slower after irradiation. Leukocyte depression after cyclophosphamide injection turns out to be remarkably rapidly reversible, the starting values in contrast to the whole-body irradiated animals in the LD 50 area being reached again in the course of a 10-day experiment. By combining whole-body x irradiation and cyclophosphamide medication in the LD 50 area the effect of the leukocytic reaction course is more marked if cyclophosphamide is applied hours or days after x irradiation than in the reverse sequence, which is also expressed by the decreased survival rate of the animals. (auth)

21402 REDUCTION OF THE EPITHELIAL CELL POPULATION AND PREMATURE DIFFERENTIATION OF CRYPT CELLS IN INTESTINAL EPITHELIUM OF IRRADIATED MICE. Kononenko, A. M.; Monastyrskaya, B. I.; Fol'ke, Yu. (Inst. of Nuclear Physics, Leningrad). Tsitologiya; 16: No. 6, 757-764(Jun 1974). (In Russian).

After the total body x irradiation of mice (400 rads), the mitotical and the cell overshooting in restoring intestinal epithelium are followed by the 2nd reduction of these parameters. By means of the model analysis the number of cells in intestinal epithelium on the 5th day after irradiation was shown to be lower than the mitotical activity. At this time an accelerated cryptal cell differentiation was revealed, which led to their early maturation. This is the 2nd wave of the crypt cell maturation (after the 1st one in the first hrs after irradiation). It seems that during the process of intestinal restoration, there is a functional morphological transformation of cells resulting in periodical change of proliferative and maturative waves. The intensity of this process fades with the restoration of the intestine, but it does not disappear altogether. The mitotical circadian rhythm of the intact epithelium is likely to be connected with the reverse-phase

diurnal rhythm of the cell differentiation intensity. The granulocytes and lymphocytes penetrating into the crypts perish during the first hrs after the irradiation while no necrosis of the cryptal epithelial cells is found. It is possible that the discrepancy in the published data concerning the dosage dependence of the cryptal cells perimitotical death is due to the interference of necrosis of the epithelial cells and of the granulocytes and lymphocytes penetrating into the crypts. (auth)

21403 COMBINED EFFECT OF RADIATION AND BLEOMYCIN ON MOUSE INTESTINAL EPITHELIAL CELLS. Tanaka, N.; Tanabe, C.; Ogawa, F.; Saeki, Y.; Ito, R. (Kyoto Univ.). Nippon Igaku Hoshasen Gakkai Zasshi; 34: No. 1, 50-57(Jan 1974). (In Japanese).

The effect of Bleomycin pretreatment on intestinal epithelial cells of irradiated mice was studied. Number of intestinal epithelial cells was determined after irradiation, either with Bleomycin pretreatment or after each treatment alone. For assessment of combination effect, intraperitoneal administration of Bleomycin was followed by a single whole-body irradiation 30 min after Bleomycin injection. Animals were examined every day, and $LD_{50/5}$ was calculated by logic analysis. $LD_{50/5}$ of animals receiving 0, 15, and 60 mg/kg of Bleomycin was 1127, 765, and 549 rad, respectively. The effect of Bleomycin and/or radiation on the number of intestinal epithelial cells was analyzed by intestinal epithelial cell reduction dose (IRD_{50} (37%)); i.e., the x-ray dose to reduce the number of intestinal epithelial cells to 37% of the control in 50% of the treated animals. Cell count was measured according to Tsubouchi and Matsuzawa's method. Combined effect of 60 mg/kg of Bleomycin and irradiation was analyzed by IRD_{50} values and compared with that of irradiation alone. The values of IRD_{50} (37%) when treated with x irradiation alone and combined with 60 mg/kg Bleomycin were 1080 and 466 rad, respectively. The D- (radiation dose to reduce surviving fraction to 1/e on the straight portion of the dose-survival curve) of mouse intestinal epithelial cells 3.5 days after irradiation was 670 rad (irradiation only) and 580 rad (with 60 mg/kg of Bleomycin), respectively. However, the difference in these values was not statistically significant. Combined effect of Bleomycin and irradiation was clearly shown in terms of the mouse $LD_{50/5}$ and by the number of mouse intestinal epithelial cell 3.5 days after irradiation. (auth)

21404 RADIATION EFFECTS ON ORAL TISSUES IN MICE. Ohta, T. (Kyushu Dental Coll., Fukuoka). Kyushu Shika Gakkai Zasshi; 27: No. 3, 200-220(Sep 1973). (In Japanese).

One hundred and seventy dd-N female mice (10-week-old) were used in a radiation study involving a single dose of localized head x-ray radiation of 500 R, 1000 R, and 2000 R (200k Vp, 19 mA, 1.53 mm Cu half value layer, 40 cm target skin distance). The irradiated animals were sacrificed in 3, 7, 11, 14, and 17 days following the treatment. The radiation dose of 500 R was not influential to the body condition and to the oral cavity, macroscopically. Microscopically, atrophy in epithelia of gingiva and tongue, and degeneration in parotid gland seen in 3 days disappeared in 17 days. But atrophy of muscle fiber, infiltration of lymphocytes, and congestion in tongue were still observed in 17 days. The radiation dose of 1000 R was influential to the body condition, but the disturbance disappeared in 17 days. Macroscopically, mucous membrane of the oral cavity revealed hyperemia and wetting in 7 days, but these findings disappeared in 17 days. Microscopically, atrophy and keratosis of skin and gingiva, degeneration of parotid gland which occurred in 3 days disappeared in 17 days. But a slight infiltration of lymphocytes and plasmocytes in derma, disappearance of lamellar structure of alveolar bone, hyalinization of collagen fiber in osseous tissue, and atrophy of muscle fiber in tongue were still observed in 17 days. The radiation dose of 2000 R to head has severe effects to whole body which lead the animal to the death in 10 or 11 days. Macroscopic lesions of mucous membrane of the oral cavity in 7 days were most severe, and ulcer was developed in mucous membrane. Microscopically, too, lesions of the oral cavity in 7 days were most severe. From the microscopic findings, the major lesions following to irradiation could be attributed to metabolic disturbance of the oral tissue, especially to regressive tissue change of the osseous tissue. (auth)

Invertebrates

Refer also to abstract 20765.

Radionuclide Effects (Internal Source)

Man

Refer also to abstracts 21060, 21070, 21087, 21416, and 21420.

21405 (BNWL-SA-4879) ENVIRONMENTAL BEHAVIOR AND RADIATION DOSES FROM IODINE-129. Soldat, J. K. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Jun 1974. Contract AT(45-1)-1830. 27p. (CONF-740702-6). Dep. NTIS $4.00.

From Health Physics Society annual meeting; Houston, Texas, USA (7 Jul 1974).

Iodine-129 is a radionuclide which, because of its long half-life (1.6×10^7 yr), has a potential for long-term accumulation in the environment from low-level chronic releases at nuclear facilities. The transfer of ^{129}I through the biosphere and the resultant radiation doses to man are discussed. Metabolic parameters are tabulated for four ages, 1, 4, 14, and adult. These parameters include fractional uptake via inhalation and ingestion, breathing rate, mass, radius and iodine content of the thyroid, and the energy absorbed per disintegration of ^{129}I versus thyroid size. Factors are presented for calculation of doses from intake or concentration of ^{129}I in the thyroid. Factors are also derived for estimating thyroid doses from ^{129}I air concentration via the inhalation, leafy vegetable, milk or meat pathways. Analysis of the atom ratios of ^{129}I: ^{127}I in the thyroid required to yield a dose rate of 1500 mrem/yr reveals that on this basis the adult thyroid reaches the limiting dose rate at a ratio of 1:48 (3.6 μCi ^{129}I/g iodine). However, a higher ratio of 1:11 (15 μCi/g I) is required for the infant thyroid to receive the same dose rate. The reason for this difference is the higher stable I concentration in the adult thyroid (350 ppM) than in the infant thyroid (90 ppM). In all instances, however, a dose rate of 1500 mrem/yr would result from a concentration of 1.3×10^{-3} μCi ^{129}I per a gram of thyroid. (auth)

21406 (CONF-740715-3) RISK OF MALIGNANCY FROM INTERNALLY-DEPOSITED RADIOISOTOPES. Rowland, R. E. (Argonne National Lab., Ill. (USA)). 1973. 30p. Dep. NTIS $4.50.

From international radiation research congress meeting; Seattle, Washington, USA (14 Jul 1974).

Extensive experience has shown that a number of radionuclides can induce malignancies when deposited in the human body. However, the relationship between the quantity of isotope deposited and the probability of subsequent induction of a malignancy is less clear. The hypothesis that the risk is linear with dose, independent of the dose rate, may be defensible in obtaining conservative estimates for use in guiding public policy. Verification of linearity, however, should be sought by studying only populations whose doses ranged over several orders of magnitude e.g., from studies of radium in man. Current ^{224}Ra injection results in patients can be described by a risk proportional to either the first or the second power of dose, but a first-power law does not adequately describe the current ^{226}Ra–^{228}Ra results. Thus these studies cast doubt on the validity of linear risk estimates for bone-seeking alpha-emitting radionuclides in man. (auth)

Animals

Refer also to abstract 21064.

21407 (BNWL-SA-4925) STUDIES OF PULMONARY CARCINOGENESIS IN RODENTS FOLLOWING INHALATION OF TRANSURANIC COMPOUNDS. Sanders, C. L.; Dagle, G. E. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). [nd]. Contract AT(45-1)-1830. 18p. (CONF-740648-3). Dep. NTIS $4.00.

From symposium on experimental respiratory carcinogenesis and bioassays; Seattle, Washington, USA (23 Jun 1974).

The influence of absorbed radiation dose and its distribution on pulmonary carcinogenesis in rats were examined following inhalation of ^{238}Pu from crushed $^{238}PuO_2$ microspheres, $^{238}PuO_2$, or $^{244}CmO_2$ and following intratracheal instillation or inhalation of $^{239}PuO_2$. A more uneven dose-distribution (e.g., $^{238}PuO_2$ or $^{239}PuO_2$) favors squamous carcinoma induction at high doses, while adenocarcinoma induction is greater at lower doses or at all doses following a more even dose-distribution in the lung (e.g., ^{238}Pu, $^{244}CmO_2$). Squamous metaplasia and adenomatosis appeared to precede the development of squamous carcinoma and adenocarcinoma, respectively. Pulmonary hemangiosarcomas were found only after high doses of inhaled $^{239}PuO_2$. These results demonstrate the importance of dose and dose-distribution on the development of pulmonary tumors from inhaled α emitters. (auth)

21408 (BNWL-SA-5049) CARCINOGENICITY OF INHALED RADIONUCLIDES. Bair, H. J. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). [nd]. Contract AT(45-1)-1830. 11p. (CONF-740702-4). Dep. NTIS $4.00.

From Health Physics Society annual meetings; Houston, Texas, USA (7 Jul 1974).

The carcinogenicity of inhaled α and β-γ emitting radionuclides has been demonstrated in a number of animal species. However, the data from these studies are inadequate to assess with confidence the relationship between the incidence of lung cancer and the radiation dose. These data are reviewed and possibilities for estimating the dose-effect relationship are discussed. Problems associated with determining the appropriate dose value that relates to cancer incidence discussed include: estimating alveolar deposition; estimating pulmonary clearance; spatial distribution of radionuclide in lung; determining tumor appearance time; and determining number of animals at risk. Approaches taken to estimate dose-effect relationship include logarithmic probit curve and mathematical models. Results of studies on laboratory mammals with inhaled $^{239}PuO_2$, $^{238}PuO_2$, ^{210}Po, and ^{106}Ru are cited as examples. It is concluded that the experimental determination of the relationship between dose and cancer incidence is difficult for all carcinogens, especially at low doses where large numbers of animals are required. The problem is especially difficult in the case of inhaled radionuclides because of the complexities of depositing known quantities of radionuclides in the lung and because of the unknown significance of spatial and temporal distribution of the radiation dose from the radionuclide that is deposited. Available data are not adequate to assess dose-effect relationships with confidence and current experiments are not likely to improve the situation. Therefore, alternatives are required to extrapolate the results from animal experiments to man for purposes of developing radiation protection standards. A possibility is a toxicological approach in which the appropriate radiation dose models needed to describe cancer induction are of secondary importance. (CH)

21409 (CH-3713) TRANSMISSION OF RADIO-STRONTIUM AND PLUTONIUM FROM MOTHER TO OFFSPRING IN LABORATORY ANIMALS. Finkle, M. P. (Chicago Univ., Ill. (USA)). 28 Jan 1947. Contract W-31-109-eng-37. 52p. Dep. NTIS $5.75.

Fetal and infant mice and rats exposed to ^{89}Sr (0.03 to 10 μc/g) and Pu (0.016 to 0.03 μc/g) by injection into the mother before conception, during pregnancy, and during lactation were observed for biological effects and radioactivity. Observations during 200 days following birth showed that animals exposed to ^{89}Sr had signs of growth retardation, bone malformations, anemia, and osteogenic sarcoma while no pathological changes were observed in those exposed to Pu. (CH)

21410 (CN-2653) MONTHLY HEALTH REPORT ON PROBLEMS RELATED TO PRODUCT FOR PERIOD ENDING JANUARY 15, 1945. (Chicago Univ., Ill. (USA)). 8 Feb 1945. Contract W-7401-eng-37. 24p. Dep. NTIS $4.25.

Results are reported from detailed clinical studies on a dog during 16 days following the intravenous injection of a lethal dose of Pu as nitrate solution. Data are included on the tissue distribution of Pu 16 days following injection. The pathological findings are compared with those observed in dogs exposed to a lethal dose (300 to 600 R) of x radiation. (CH)

21411 (COO-3167-106) BIOLOGICAL EFFECTS OF NUCLEAR POWER SOURCES FOR ARTIFICIAL HEART DEVICES. Annual Progress Report, June 1, 1973–May 31, 1974. Kalifelz, F. A. Comar, C. L.; Casarett, A. P. (New York State Veterinary Coll., Ithaca (USA). Dept. of Physical Biology). 1974. Contract AT(11-1)-3167. 30p. Dep. NTIS $4.50.

Among the various problems associated with the development of a complete artificial heart utilizing a ^{238}Pu source for power is the effect of heat and radiation from the Pu source. The biological effects of radiation from such power sources were investigated using a mock source which would simulate the radiation flux from a 30 Watt ^{238}Pu source but would not have any associated heat. For this purpose, ^{252}Cf was used to provide the neutron flux of ^{238}Pu and ^{90}Sr–^{90}Y bremsstrahlung sources to provide the additional photon component to bring the γ radiation flux from the ^{252}Cf up to that of a 30 Watt Pu source. This combination approximated very closely the radiation characteristics of a 30 Watt ^{238}Pu source. A stainless steel hollow ball, 333 ml in volume having an outside diameter of 3.25 inches, was used as the basic implantation device. This stainless steel implantation capsule was loaded with the appropriate sources, sealed, covered with medical grade silicone rubber, and implanted in Labrador Retriever dogs. This animal was chosen since it had a relatively long life span and was of a size that would allow implantation of a device similar to that which might be used in the human being. The implantation capsules were placed in the left flank of the dog between the internal and external abdominal oblique muscles; thus, roughly a retroperitoneal position of the source was assured. Data are presented on the radiation doses to various organs and surface sites and the biological effects as determined from results of a battery of clinical tests performed at monthly intervals. The results of studies during a two to three year period indicate that, while certain changes do occur as a result of radiation from nuclear power sources which might be used to power artificial hearts, these changes are very minimal when the radiation dose of a 30 Watt source is being considered. (CH)

Nuclide Kinetics and Toxicology

21412 ASSESSMENT OF URANIUM AND PLUTONIUM BODY BURDENS. Methods and Techniques. Koenig, L. A.; Schieferdecker, H. (Nuclear Research Center, Karlsruhe, Ger.). At. Energy Rev.; 12: No. 2, 343-417(1974).

A review is given of the methods and techniques of assessment of uranium and plutonium body burdens. Following fundamental physical, chemical, and metabolic properties, radiation protection guide values are reported, together with derived working levels for excretion analysis. A detailed description relates to the methods of assessment of body burden by in vivo counting and excretion analysis under normal operation and following accidental intake. Techniques of interpreting the results measured are described. (209 references) (auth)

Man

Refer also to abstracts 20643, 20731, 21063, 21065–21071, 21074–21076, 21124, 21188, and 21477.

21413 (BNWL-tr-126) LUNG CANCER HAZARDS BY INHALATION OF ^{222}Rn DECAY PRODUCTS. Jacobi, W. Translated from Biophysik; 10: 103-114(1973). 17p. Dep. NTIS $4.00.

The results of surveys in the USA and the CSSR about the lung cancer mortality among uranium miners are compared. The relation between the observed excess lung cancer mortality and the cumulative exposure of these miners by inhaled ^{222}Rn daughters is discussed and the risk coefficients for radiation-induced lung cancer are estimated. The relative risk coefficients of both study groups of U-miners agree within the confidence limits and are in the range of 0.001 to 0.005 WLM^{-1}. The derived absolute risk coefficients of 20 ± 10 (USA group) and 150 ± 50 (CSSR group) additional lung cancer deaths per WLM and 10^6 miners are, however, significantly different. The influence of synergistic or cocarcinogenic factors is discussed. The increase of lung cancer mortality with Rn-exposure is significantly correlated with an increase of the small-cell, undifferentiated type of carcinoma. (auth)

21414 (CH-3607) DISTRIBUTION AND EXCRETION OF PLUTONIUM IN TWO HUMAN SUBJECTS. Russell, E. R.; Nickson, J. J. (Argonne National Lab., Ill. (USA)). 2 Oct 1946. Contract W-31-109-eng-38. 26p. Dep. NTIS $4.50.

Plutonium-239 tissue distribution and excretion studies were made in two human-subjects given total intravenous doses of 5 and 94.91 micrograms of Pu citrate. No clinical effect was noted which could be attributed to the biological action of the element in 155 and 16 days of observation respectively. (auth)

21415 (CONF-740708-11) COMPARISON OF IODIDE AND PERTECHNETATE TRAPPING AND LOSS IN THE HUMAN THYROID GLAND. Dige-Petersen, H. (Rigshospitalet, Copenhagen (Denmark)). 1973. 11p. (SM-185/58). Dep. NTIS (US Sales Only) $4.00.

From symposium on dynamics studies with radioisotopes in clinical medicine and research; Knoxville, Tennessee, USA (15 Jul 1974).

Neck and thigh activity were measured continuously by scanning following administration of ^{132}I to patients with various thyroid discrasias and before and after blocking the iodine uptake. In this way an individual correction of the early uptake and clearance values could be performed. The mean relative increase of the unidirectional clearance after the correction was 1.68. If, however, reliable measurements were obtained from 2 min post injection, no significant increase resulted from the special correction, and it could be omitted. Another group of 8 patients was given a simultaneous injection of ^{132}I and $^{99m}TcO_4$. In all cases the unidirectional clearance of iodine was higher than that of pertechnetate, on the average by a factor of 2. The relation between the unidirectional clearance of the two ions was fairly constant in different functional states of the thyroid gland. The rate of loss of pertechnetate was higher than that of iodine. The results indicate a quantitative, but possibly not a qualitative, difference in the trapping mechanism of iodine and pertechnetate. (auth)

21416 (KFK-1899, pp 7-22) FUTURE ICRP CONCEPT FOR THE DERIVATION OF LIMITS FOR THE INHALATION OF RADIOACTIVE AEROSOLS. Jacobi, W. (Gesellschaft fuer Strahlen-und Umweltforschung mbH, Neuherberg/Muenchen, Ger.). Mar 1974. (In German).

The ICRP-task group model for the deposition and retention of radioactive particles in the respiratory tract is described and its consequences for the distribution of inhaled radioactive material within the human body are discussed. The evaluation of the specific effective energy and the dose commitment-concept are explained. Finally the new system of limits for the incorporation of radioactive material is outlined. Instead of limiting the activity concentration in air and water this new system provides a limitation of the integral annual activity intake into the human body by inhalation or oral ingestion. (auth)

21417 (N-2024) MONTHLY SUMMARY. Nickson, J. J. (Chicago Univ., Ill. (USA)). 18 Jun 1945. 12p. Dep. NTIS $4.00.

Data are presented from the routine analysis of personnel urine samples as an indication of the body content of Pu. Methods used for preparation of the samples for radiometric analysis are described. Data are included on the urinary excretion of Pu during a 4-mo period following injection of 6.7 μg of Pu into a human volunteer. (CH)

21418 (N-2273) BIOCHEMISTRY SURVEY SECTION REPORT FOR THE MONTH MAY 1946. Nickson, J. J. (Chicago Univ., Ill. (USA)). 20 May 1946. 6p. Dep. NTIS $4.00.

Analysis of the urine will give a fair indication of the Pu incorporated in the body. However, material taken into the lungs is not readily absorbed and a portion of it is eliminated by way of the intestines. From animal experiments it was shown that from 10 to 20% of that reaching the lungs is retained after 90 days. This, then, imposes an additional hazard if individuals constantly work in areas in which the air is even slightly contaminated with Pu. In order to place an additional safeguard on the individual worker, frequent stool and sputum analyses should be made along with the urines. Two cases are reported in which individuals had worked in areas with above tolerance air counts of Pu. In one case the individual remained at home for nearly two weeks and collected urine, sputum, and stool specimens. There was a decrease in the amount of Pu eliminated with the stools. However, it was not possible to calculate accurately the amount of material retained. Preliminary results are reported from studies in dogs of the effects of the following treatments on Pu excretion; injection daily with 5cc of a 3% sodium citrate solution for 10 days; Pb administration followed by an acidosis-producing diet; subcutaneous injection of 10 mgms of BAL/kg body weight; and the intravenous injection of increasing amounts of Zr in citrate solution. Administration of Zr (44 and 88 mgms doses administered three times during a 30-day period) resulted in Pu excretion 2.5 times normal. (CH)

21419 (N-2302) BIOCHEMISTRY SURVEY SECTION REPORT FOR THE MONTH JUNE 1946. Russell, E. R. (Chicago Univ., Ill. (USA)). 20 Jun 1946. 11p. Dep. NTIS $4.00.

Data are reported on the radioactivity levels in air in a Pu work area and the amount of Pu excreted in feces of personnel working in the area, as determined by radiometric analysis of samples. Results are reported from an experiment in which six individuals drank a solution containing a known tracer amount of Pu, and urine excreted during the next six days was analyzed for Pu. Results showed that less than 0.1% of ingested Pu was absorbed. It was concluded that the biological half-life of Pu in the human intestines is sufficiently different from that in the lungs for Pu deposited in the lungs to be determined by the analysis of feces samples over a two-week period. Results of studies in rats of Pu therapy by metal displacement showed that the intraperitoneal injection of Zr in citrate solution (500 mgms Zr per kilo body weight administered twice) increased Pu excretion in urine by 1.2%. (CH)

21420 REPORT ABOUT A PLUTONIUM-239 CONTAMINATED LACERATED AND INCISED WOUND. Ohlenschlaeger, L.; Schieferdecker, H. (Kernforschungszentrum Karlsruhe (F. R. Germany). Medizinische Abt.). Strahlentherapie; 146: No. 6, 675-684 (Dec 1973). (In German).

3 figs.; 3 tabs.; 6 refs.

Diagnostic-therapeutic measures are reported for a plutonium-239 contaminated lacerated and incised wound on the extensor side of the right wrist joint. The alpha activity measured at the wound was about 200 nCi and could be lowered to 7 nCi by one single excision of the wound secretion starting on the fifth day after excision of the wound lip. Intravenous medicamentous therapy carried out in support with Na_3[Ca-DTPA] (Ditripentat Heyl) produced a marked reduction in the initial deposition in the body. Based on activity analyses performed with urine and fecal samples and using the equations proposed by Langham as well as by Beach and Dolphin, the problem is discussed of an early and ultimate estimate of the body burden, when Na_3[Ca-DTPA] is employed for treatment. (auth)

21421 URANIUM. Plutonium. Transplutonic Elements. Hodge, H. C.; Stannard, J. N.; Hursh, J. B. (eds.). Berlin, F. R. Germany; F. R. Germany; Springer (1973). 995p. (ISBN 35400-61681; ISBN 0387061681).

243 figs.; with tabs. and refs.

This book provides a comprehensive survey of the properties of uranium, plutonium, and the transplutonic elements. In the first part of the book dealing with uranium, the first chapter on the history of uranium poisoning from 1824 to 1942 is followed by a detailed discussion of the physical and chemical properties of uranium. Chapter 3 deals with animal experiments on the distribution, excretion and toxic action of uranium, and the findings described there are complemented by data on man, given in chapter 4, whereas chapter 5 and 6 discuss protection criteria and environmental monitoring and personnel protection in uranium processing. Chapter 7 discusses the problems inherent in producing uranium ores, methods of evaluation of hazards, and control procedures. Part II of the book is intended to provide the pharmacologist and toxicologist with information on the biomedical aspects of the isotopes of plutonium, the chemical and physical properties of the element plutonium, as well as its properties and effects as a bone-seeker and its behavior in soft tissues, with emphasis on the respiratory tract. Chapter 12 of this second section discusses the history and biological bases of the definition of MPB and MPC values, and chapter 13 the detection of plutonium in biological materials, followed by a chapter on industrial hygiene, health physics and related aspects. The final chapter of this section deals with plutonium in the environment. The structure of the third and last part on transplutonic elements follows the pattern of the two preceding sections, discussing the history of transplutonic elements, their physical and chemical properties, metabolism and biological effects, health physics data and the bioassay of transplutonium elements. The final chapter deals with the medical uses of ^{241}Am and ^{252}Cf. (GE)

21422 ROLE OF FRESHWATER AS POSSIBLE SUPPLIER OF ^{32}P TO POPULATION UNDER CONDITIONS OF POLLUTION OF NATURAL BASIN BY THIS RADIONUCLIDE. Saurov, M. M.; Korotkov, K. B.; Gneusheva, G. I.; Novoselova, G. P.; Tribunskaya, T. A. pp 177-184 of Radioekologiya Vodnykh Organizmov. II. Raspredelenie i Migratsiya Radionuklidov v Presnovodnykh i Morskikh Biotsenozakh. Andrumaitis, G. P. (ed.). Riga; Izdatel'stvo Zinatne (1973). (In Russian).

The accumulation of ^{32}P by some species of freshwater fish was studied. The accumulation of this nuclide depends on the kind of fish, its age, and the degree of enrichment of the organs and tissues by the stable phosphate. The population of riverside districts may receive 40 to 200 times as much ^{32}P with fish as with water of the same basin. (auth)

21423 INTERPRETING BOTH SHORT- AND LONG-TERM POWER LAWS IN PHYSIOLOGICAL CLEARANCE CURVES. Wise, M. E. (Leiden Univ.). Math. Biosci.; 20: No. 3/4, 327-337 (Aug 1974).

Clearance curves for radiocalcium can be separated into a part closely fitted by $at^{-\alpha}$ or by $at^{-\alpha}\exp-\beta t$, $0.2 < \alpha < 0.5$; the latter changes into a second power function At^{-W}, where W is usually between about 0.9 and 1.5. The previous model for explaining the first power without compartments was extended to allow for the second power; according to this, each injected radiocalcium atom undergoes bone–non-bone cycles with a probability p that such a cycle is broken by excretion in the non-bone phase. It is shown in particular how increasing p from zero to nearly 1 influences the observed clearance curves: for $p = 0$, $W > 1.5$, while, as p approaches utility, W approaches the value for the short term power α. (auth)

Animals

Refer also to abstracts 21064, 21082, 21125, 21126, 21137, 21143, 21489, 23394, and 23395.

21424 (BNWL-SA-5042) EFFECTS OF INHALED URANIUM MINE AIR CONTAMINANTS IN BEAGLE DOGS. Stuart, B. O.; Filipy, R. E.; Palmer, R. F.; Ragan, H. A.; Hackett, P. L. (Battelle Pacific Northwest Lab., Richland, Wash. (USA)). [nd]. Contract AT(45-1)-1830. 21p. (CONF-740648-2). Dep. NTIS $4.25.

From symposium on experimental respiratory carcinogenesis and bioassays; Seattle, Washington, USA (23 Jun 1974).

Preliminary results are reported from studies on beagle dogs of the biological effects of daily exposure to known levels of uranium mine air contaminants, including radon daughters and uranium ore dusts, with and without cigarette smoke. Data are reported on pathological changes in the respiratory tract observed in cells obtained by lung washing, in samples obtained at autopsy, and monthly measurements of respiration rates. No neoplastic

lesions were observed in dogs exposed over a three- and four-year period, but numerous foci of squamous metaplasia of alveolar epithelium, fibrosis, and pulmonary empysemia were observed. (CH)

21425 (CN-2383) METABOLISM OF PRODUCT FOR PERIOD ENDING OCTOBER 15, 1944. Hamilton, J. G. (Chicago Univ., Ill. (USA)). 23 Nov 1944. 22p. Dep. NTIS $4.25.

The results of detailed metabolic studies of Pu in rats following oral, intramuscular, intravenous, subcutaneous, and intrapulmonary administration are presented. Plutonium was not absorbed from the digestive tract. The skeleton was the chief organ of deposition for Pu absorbed by the body following parenteral administration. The digestive tract was the principal channel of elimination and the degree of retention was very great. The rate of excretion was very slow and the half-period of retention of Pu by the skeleton was estimated to exceed six months. No significant differences in the metabolic properties of Pu absorbed by the body were observed for its three valence states. Considerable retention of Pu by the lungs following intrapulmonary administration was observed and was found to be highest for the +4 state, less for +3 Pu, and least for +6 Pu. A significant degree of absorption of Pu from the lungs with subsequent deposition in the skeleton took place following the intrapulmonary administration of solutions of this element in its three valence states. (auth)

21426 (CN-2546) MONTHLY HEALTH REPORT ON PROBLEMS RELATING TO PRODUCT FOR PERIOD ENDING DECEMBER 31, 1944. (Chicago Univ., Ill. (USA)). 9 Jan 1945. Contract W-7401-eng-37. 28p. Dep. NTIS $4.50.

Preliminary results are reported from studies on Pu toxicity in mice and rats following intravenous injection of lethal and sublethal doses of $PuO_2(NO_3)_2$ or the inhalation of PuO_2 smokes. Pathological changes in the histology of liver, spleen, kidneys, and bone marrow and changes in blood chemistry are described. The toxic effects of Pu were compared with those of Ra. Results of autoradiographic studies of Pu distribution in bone tissues are also reported. (CH)

21427 KINETICS OF WHOLE-BODY AND ORGAN ACTIVITY FOLLOWING INTRAVENOUS INJECTION OF ^{177}Lu INTO RATS. Marx, R. Berlin, Ger.; Freie Univ. (1972). 44p. INIS. (In German).

22 figs.; 27 refs. With abstract. Available from the library of the Freie Univ. Berlin.

Diss. (M.D.).

Studies on the distribution of ^{177}Lu in experimental animals were carried out to investigate the feasibility of using radioactive isotopes of lutetium in nuclear medicine. The kinetics of the whole-body activity and of the radioactivity in 16 organs (whole blood, liver, spleen, stomach, small intestine, large intestine, pancreas, kidneys, adrenal glands, lungs, heart, skeletal muscles, bones, costal cartilage, testes, epidermis) after i.v. injection of 10 μCi of (carrier-free) ^{177}Lu were studied in male Wistar rats for a period of at least 32 days. About 15% of the injected amount of radioactivity is excreted in the first 24 h, and only another 10% during the following ten days. The effective half-life of the ^{177}Lu in the whole body is 6.2 d on the 11th day following injection, and the biological half-life is 70 d. The biological and effective half-lives in the bones (femur) are only slightly longer, whereas that of the other organs are markedly shorter, namely 11 to 37 d for the biological and 4.2 to 5.7 d for the effective half-life. The ^{177}Lu is most rapidly removed from the skeletal muscles, heart, liver, kidneys and lungs. More than 1% of the injected dose/g of organ is found in the lungs, kidneys and bones in the first 4 h p.i. Accumulation of the ^{177}Lu in the bone increases up to the 8th day p.i. and then declines. In all other organs, the radioactivity has been found to decrease more or less rapidly already after 4 h p.i. An interesting result with regard to bone scintigraphy is that the osseous skeleton contained 90.1% of the injected dose on the 8th day following i.v. injection of $^{177}LuCl_3$. (GE)

21428 STUDIES OF ACUTE CARDIOPULMONARY TOXICITY OF SN-MACROAGGREGATED ALBUMIN IN THE DOG. Allen, D. R.; Nelp, W. B.; Cheney, F.; Hartnett, D. E. (Univ. of Washington, Seattle). J. Nucl. Med.; 15: No. 7, 567-571(Jul 1974).

A dog model was developed for testing the effect of intravenous injection of stannous macroaggregated albumin particles (Sn-MAA) used as carriers of radioisotopes for scintiscanning patients. Throughout the study the most sensitive and conveniently measured indicator of acute particle toxicity was an immediate elevation in mean pulmonary artery pressure. In the studies of normal dogs it was possible to construct a dose-response curve of toxicity relating increase in mean pulmonary artery pressure to the number of 30-micron Sn-MAA particles injected as a single bolus. The dose-response curve indicated the first sign of acute toxicity occurred when approximately 100 times the usual lung scan dose (LSD) was given. A safety factor of 100 in humans for this product was derived by relating the number of particles injected to body weight. In additional studies in dogs with experimental pulmonary hypertension there was no significant effect noted after the single injection of 1×10^8 particles, which is the equivalent of three human lung scan doses of particles. (auth)

21429 DISTRIBUTION OF ^{14}C AND ^{3}H-STREPTOZOTOCIN IN DOGS AND TOADFISH. Ryo, U. Y.; Beierwaltes, W. H.; Feehan, P.; Ice, R. D. (Univ. of Michigan, Ann Arbor). J. Nucl. Med.; 15: No. 7, 572-576(Jul 1974).

Streptozotocin is a 2-deoxy-D-glucose derivative of N-methyl-N-nitrosourea isolated from Streptomyces achromogenes. It is an antibiotic active against a variety of organisms. Since streptozotocin shows a highly specific action on the function of islet cell tissue of the pancreas, a tissue distribution study of the labeled compound was completed to evaluate possible concentration of streptozotocin in the beta cells. Ten dogs and 46 toadfish were injected intravenously with ^{14}C- or ^{3}H-labeled streptozotocin. Tissue distribution studies were completed in dogs at 1, 2, 3, 4, 6, or 24 hr and in toadfish at 10 min, 1, 2, 3, 4, 6, or 24 hr. No selective concentration of labeled streptozotocin occurred in dog pancreas at any time interval. Islet cells of the toadfish also failed to show specific concentration of streptozotocin. There was no significant difference in the pattern of distribution and excretion between both labeled compounds. (auth)

21430 ALIMENTARY TRACT IN ACCUMULATION OF ^{137}Cs BY GUDGEON. Stepin, A. A. pp 147-151 of Radioekologiya Vodnykh Organizmov. II. Raspredelenie i Migratsiya Radionuklidov v Presnovodnykh i Morskikh Biotsenozakh. Andrumaitis, G. P. (ed.). Riga; Izdatel'stvo Zinatne (1973). (In Russian).

To reveal the role of the alimentary tract in the accumulation of long-living radionuclides by fish, an experiment was carried out using a simplified three-link model water-mosquito larvae-fish. The experiments showed that the main path of ^{137}Cs entrance into gudgeon is the absorption via the skin and gill apparatus. (auth)

21431 UPTAKE OF ^{90}Sr BY ORGANISMS OF GAMMARUS SP. AND CHIRONOMUS f.l. PLUMOSUS L. Marciulioniene, D. P.; Striupkuviene, N. K.; Polikarpov, G. G. pp 152-159 of Radioekologiya Vodnykh Organizmov. II. Raspredelenie i Migratsiya Radionuklidov v Presnovodnykh i Morskikh Biotsenozakh. Andrumaitis, G. P. (ed.). Riga; Izdatel'stvo Zinatne (1973). (In Russian).

It was observed experimentally that Gammarus sp. accumulates ^{90}Sr with a considerably larger concentration factor than Chironomus, plumosus L. The concentration factor (for dry weight) of Gammerus sp. is 3165, but that of Chironomus, plumosus L. is only 21. ^{90}Sr is accumulated by Gammerus sp. and Chironomus f.l. plumosus L. in larger quantities from aqueous media than from radioactive food. However, the smaller uptake of ^{90}Sr from aqueous media and the larger quantities of this radionuclide accumulated in the food, the more important is the role of the food factor in the accumulation of ^{90}Sr in the organism. Besides, Gammarus sp. and Chironomus plumosus L. assimilate ^{90}Sr from radioactive food in comparatively small quantities (20% and 10% respectively). (auth)

21432 MIGRATION OF ^{90}Sr FROM FISH INTO PROGENY. Kulikova, V. G.; Kulikov, N. V. pp 169-176 of Radioekologiya Vodnykh Organizmov. II. Raspredelenie i Migratsiya Radionuklidov v Presnovodnykh i Morskikh Biotsenozakh. Andrumaitis, G. P. (ed.). Riga; Izdatel'stvo Zinatne (1973). (In Russian).

Data on the excretion of ^{90}Sr from female fish of two species (Lebistes reticulates Peters, Macropodus opercularis L.) and ova in the period of spawning are presented. It was observed that the migration of ^{90}Sr from fish is determined by the degree of development of ova, the concentration of radionuclides, and the general mass of ova in the organism. (auth)

21433 BIOLOGICAL EFFECT OF ^{106}Ru AND ^{131}I ON WATER ORGANISMS. Gus'kova, V. N.; Mashneva, N. I.; Rodionova, L. F.; Kupriyanova, V. M.; Zasedatelev, A. A.; Sukal'skaya, S. Ya. pp 185-193 of Radioekologiya Vodnykh Organizmov. II. Raspredelenie i Migratsiya Radionuklidov v Presnovodnykh i Morskikh Biotsenozakh. Andrumaitis, G. P. (ed.). Riga; Izdatel'stvo Zinatne (1973). (In Russian).

Experimental data on the accumulation kinetics and biological effect of ^{131}I and ^{106}Ru+Rh on aquatic organisms (microflora, plankton, spawn, larvae, and adult fish) under the conditions of single intake in concentrations 10^{-6} to 10^{-2} Ci/l are presented. The studied nuclides in concentrations of 10^{-3}-10^{-5} Ci/l have some biological effect on hydrobionts. Lower concentrations are harmless. The accumulation of ^{131}I and ^{106}Ru+Rh depends on the stage of evolution of the hydrobionts. The maximum accumulation coefficients were observed for plankton (hundreds-thousands), the minimum ones (units-tens) for spawn, larvae and fish. (auth)

21434 DISTRIBUTION OF ^{86}Rb IN DIFFERENT PARTS OF THE LIVER. Ohnhaus, E. E. (Medizinische Universitatsklinik, Basel). Petrol. Times; 346: 157-161(1974).

The ^{86}Rb-uptake was investigated in the seven different lobes of the rat liver, in order to see differences in the intrahepatic blood distribution. It was found that the blood flow in the processus papillaris anterior and in the processus papillaris was significantly higher than in the rest of the liver. Therefore, in physiological and pharmacological experiments in rats concerning liver blood flow the radioactivity in the total liver should be measured. A higher ^{86}Rb-uptake/1 g liver, representing more accurately the real percentage of blood flow delivered to the liver, would be obtained and the variance of the method reduced. (auth)

21435 INHIBITORY EFFECTS OF CALCITONIN ON LIPOLYSIS AND ^{47}CALCIUM ACCUMULATION IN RAT ADIPOSE TISSUE IN VIVO. Werner, S.; Loew, H. (Karolinska Sjukhuset, Stockholm (Sweden). Dept. of Endocrinology and Metabolism). Horm. Metab. Res.; 6: No. 1, 30-36(Jan 1974).

9 figs.; 28 refs.

In rat epididymal tissue in vitro, calcitonin had an antilipolytic effect, measured as a depressed glycerol release into the incubation medium. In particular basal lipolysis was affected, but the antilipolytic effect of calcitonin could also be demonstrated during slightly stimulated lipolysis with parathyroid hormone, noradrenaline, or dibutyryl cyclic AMP. During marked and maximal stimulation of lipolysis no antilipolytic effect of calcitonin was noted. The accumulation of ^{47}Ca in the fat tissue, previously shown to increase with increasing lipolysis, was also depressed by calcitonin. This depression, in contrast to the antilipolytic effect of calcitonin, became more significant with increasing lipolysis. The antilipolytic effect of calcitonin was maintained after adrenalectomy, while during in vivo glucocorticoid excess it was diminished, seemingly due to decreased tissue sensitivity. Calcitonin did not modify the highly significantly decreased calcium accumulation in the tissue, seen after adrenalectomy, or the increased calcium accumulation noted after injections of high doses of cortisone acetate. The results indicate that calcitonin may have a cyclic AMP-dependent effect on lipolysis. The effect of calcitonin on calcium accumulation seems to be independent of the adenylate cyclase-cyclic AMP system as it is demonstrable during direct lipase activation by dibutyryl cyclic AMP. The two noted effects of calcitonin are discussed with special reference to known effects of two other antilipolytic substances, insulin and nicotinic acid. (auth)

21436 CLINICAL EVALUATION OF ^{67}Ga-CITRATE IN ORAL MEDICINE AND ITS MECHANISM STUDIES IN MICE. Ito, S. (Kanazawa Univ., Japan). Kanazawa Irigaku Sosho; 94: 37-64(Dec 1974). (In Japanese).

This paper is intended to report the results of studies on the mechanism of accumulation of ^{67}Ga-citrate in the animal tumor cell. When tumor-bearing mice were sacrificed at varying intervals after the injection of ^{67}Ga and the organs were assayed for radioactivity. Relatively high concentrations were usual in the liver, bone, tumor, spleen, intestinal mucosa, and kidney but assays showed a wide range of values in all tissues. Author has also illustrated with whole-body autoradiograms an uneven distribution in certain tissues. A study was made also on the distribution of synthesized chemical compounds such as Ga-lactate, pyruvate, tartarate, and gluconate in the organs of tumor-bearing mice. The distribution of the above-mentioned Ga-compounds gave the same pattern as that of Ga-citrate. This result suggests that the initial active form of gallium in the tumor localization process is an ionic one. When the carrier was present, the accumulation of the ^{67}Ga in bones and kidneys was greatly increased while the uptake in other organs such as tumor, liver, and intestine was remarkably decreased. Intracellular localization of ^{67}Ga was demonstrated autoradiographically in Ehrlich's tumor cells. After homogenization of the tumor cells and ultracentrifugation of the homogenate, it was shown that the main part of the activity occurred in the cytoplasm. In cytoplasm the large activity was found in the mitochondria and microsome fractions. As a further experiment, the excretion following subcutaneous injection of ^{67}Ga-citrate in Ehrlich's tumor-bearing mice was measured. The excretion of ^{67}Ga in feces was significantly and consistently greater than that in urine. When the carrier was present, the excretion of the ^{67}Ga was greatly and rapidly increased, and the excretion of ^{67}Ga in urine was significantly greater than that in feces. Clinically, ^{67}Ga scintiscans were performed in 33 cases with a variety of malignant, benign, and inflammatory lesions of oral medicine. (auth)

Plants

Refer also to abstract 21132.

21437 (BNWL-SA-5050) IODINE UPTAKE PATTERNS AND WATER USE BY SEVERAL CROP PLANTS. Cline, J. F.; Klepper, B. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). [nd]. Contract AT(45-1)-1830. 15p. (CONF-740702-5). Dep. NTIS $4.00.

From Health Physics Society annual meeting; Houston, Texas, USA (7 Jul 1974).

Soil-plant concentration factors for radioiodine are needed for dose-to-man calculations involving ^{129}I, a fission product which has a sufficiently long half-life that it will become a part of the iodine pool of the biosphere. Experiments were done on eight species growing in pots in soil amended with Na ^{125}I. Radioiodine was either applied carrier-free or it was applied along with NaI to give 5, 10, and 15 ppM iodide. Concentration factors depended on plant species, on leaf age, and on soil iodine content and varied from 0.05 for young lettuce leaves in soil amended with carrier-free Na ^{125}I to 609 for older spinach leaves growing in soil with 15 ppM I. There was no correlation between water use and radioiodine content of shoots. (auth)

21438 (FRNC-TH-469) RESEARCH ON ROOT ABSORPTION AND THE MIGRATION OF ^{24}Na LABELED SODIUM IN WHEAT AND BARLEY. Effects on Growth and Mineral Composition of Whole Young Plants. El Dahhak, A. J. (Grenoble-1 Univ., 38 (France)). 1972. 142p. (In French). Dep. NTIS (US Sales Only) $10.25.

Thesis. Submitted to Universite Scientifique et Medicale de Grenoble (France).

The behavior of both low and high sodium concentrations in cultivated land was studied together with the effect of such concentrations on the growth and chemical composition of plants. Experiments were carried out on species from large cultivations, a hard wheat (Triticum vulgare, variety BIDI 17) from Algeria, and a barley (Hordeum vulgare) from France. Whole plants were used. They were cultivated in a doubly diluted Hoagland medium for 3 weeks. The overall K, Ca, and Mg cation concentration was 10 meq/l. Short duration experiments (22 hours) enabled the absorption and migration of ^{24}Na labeled sodium to be studied for increasing NaCl concentrations (0.1, 1.0, 10 and 20 meq/l). The sodium absorption is a function of the sodium concentration in the medium when this concentration is less or equal to 20 meq/l. The effect of calcium, magnesium and potassium interactions at different concentrations on the absorption and migration of sodium is discussed. The aerial parts of the plant always contain more than 50% of the total quantity of sodium possessed by the plant. This fraction increases with the sodium concentration in the absorption medium. In addition, it was shown how during the first five weeks development of the young plants, increasing NaCl concentrations (0, 10, 30, 60, 120 and 180 meq/l) in various complete nutritive media modify growth by progressively disturbing the absorption and distribution of the mineral macroelements K, Na, Ca, Mg, Mn, N and P in the various tissues. (FR)

21439 (NERC-LV-539-33) RETENTION OF ELEMENTAL AND PARTICULATE RADIOIODINE ON ALFALFA. Mason, B. J.; Brown, K. W.; Hop, H. W.; McFarlane, J. C. (National Environmental Research Center, Las Vegas, Nev. (USA)). Jul 1974. Contract AT(26-1)-539. 19p. Dep. NTIS $4.00.

Synthetic particulate and gaseous ^{131}I contaminants were deposited on a three-week-old stand of alfalfa. One portion of the samples collected during the test was washed with a detergent solution. The analysis of these samples revealed that a fraction of the ^{131}I could be removed by this method but that the plants would have to be cleaned during a very short period of time following contamination in order to have any appreciable benefit. The retention of the iodine on the vegetation appears to be particle size dependent during early time periods with the larger particles having a shorter effective half-life; however, during the second phase of the loss of ^{131}I from the plants there was no effect on particle size. The elemental ^{131}I contaminant showed essentially no rapid early loss but decayed with an effective half-life close to the physical decay rate. (auth)

21440 (UCR-34P51-37) BEHAVIOR OF CERTAIN SYNTHETIC CHELATING AGENTS IN BIOLOGICAL AND SOIL SYSTEMS. Annual Progress Report Including a 15-Year Summary of Reports from this Project. Wallace, A. (California Univ., Riverside (USA)). 15 May 1974. Contract AT(04-3)-34. 106p. Dep. NTIS $8.50.

Synthetic chelating agents have proved to be very useful in laboratory tests as a soil extractant to predict availability of some micronutrients to plants. Although the tests have worked well to simulate some species of plants, the results do not apply uniformly to all species. From a study of the ramifications of these results and with continued efforts to elucidate all the factors involved, it can be expected that these tests can be sufficiently refined to

eventually predict with some accuracy the availability to a given plant of some micronutrients. The techniques are being expanded to include availability to plants of at least one transuranic element, ^{241}Am, and several different trace elements which are not essential to plants, but which are potentially toxic because of amounts of them which are being released into the environment. In this category are cadmium, lead, cobalt, nickel, and some others. The chelating agent DTPA (diethylenetriamine pentaacetate) has been very useful in simulating some plant roots in the uptake (or extraction) of zinc, iron, and copper. The agent EDDHA (ethylenediamine di (o-hydroxyphenylacetate acid)) has been useful in the simulation of iron uptake by some, but not all, species. The use of isotope tagging has given some insight into differences among plant species and forms in the soil which are available. (auth)

21441 ENVIRONMENTAL CONTAMINATION BY URANIUM. IV. Uranium Absorption by Chinese Cabbage. Yamamoto, T. (Hygienic Lab. of Okayama Prefecture, Japan); Masuda, K. J. Radiat. Res.; 15: No. 1, 1-6(Mar 1974).

Uranium absorption in the leaves of Chinese cabbage was studied under water and soil cultures. In water culture, Chinese cabbage was cultivated for 7 days at various pH of the cultivating medium containing various amount of uranium. As the concentration of both uranium ions (uranyl ion and uranyl-carbonate complex anion) in the medium increased and as pH of the medium increased, there was an increase in the uranium content of the leaves. There was no significant difference in the absorption by Chinese cabbage between uranyl ion and uranyl-carbonate complex anion. In soil culture, Chinese cabbage was grown on volcanic ash, sandy and alluvial soils which absorbed varied amounts of uranium. As uranium content of a soil was raised, the amount of uranium transferred to the leaves increased. The uranium content in the leaves decreased during their growth and its decline was generally exponential against days after sowing. (auth)

New Tracer Techniques

Refer also to abstracts 21162, 21415, 21428, 21429, and 21436.

21442 (CONF-740708-2) DYNAMIC STUDIES WITH A MULTIPROGRAMMED COMPUTER SYSTEM. Alpert, N. M.; Hoop, B. Jr.; Chesler, D. A.; Correll, J. E.; Jones, T.; Brownell, G. L. (Massachusetts General Hospital, Boston (USA). Physics Research Lab.). 1974. 21p. (SM-185/50). Dep. NTIS (US Sales Only) $4.25.

From symposium on dynamics studies with radioisotopes in clinical medicine and research; Knoxville, Tennessee, USA (15 Jul 1974).

Dynamic radionuclide studies aimed at the development of new instrumentation, the development of efficient data handling and analysis techniques, and the study of dynamic processes in both clinical and research applications are reviewed. A multicrystal positron camera was constructed which is capable of imaging positron emitting radiopharmaceuticals at high data rates and with good spatial resolution. To make efficient use of these and other data from devices such as the Anger camera, a multiprogrammed computer system (NUMEDICS) has been developed for on-line data acquisition, processing and display. A unique feature of NUMEDICS permits data acquisition, processing and display to be carried out simultaneously. NUMEDICS is being used in a wide variety of clinical and research applications and to study the problems of on-line data processing in dynamic function studies. Examples cited include measurements of regional blood flow and oxygen utilization in the myocardium and brain using ^{99m}Tc-human serum albumin microspheres, ^{15}O, and ^{13}N as tracers. (CH)

21443 (CONF-740708-3) DYNAMIC STUDIES OF THYROID FUNCTION USING PARENTERAL NaI-123. Ashkar, F. S.; Beaver, J. E.; Hupf, H. B. (Miami Univ., Fla. (USA). School of Medicine). 1970. 6p. (SM-185/79). Dep. NTIS (US Sales Only) $4.00.

From symposium on dynamics studies with radioisotopes in clinical medicine and research; Knoxville, Tennessee, USA (15 Jul 1974).

The dynamic thyroid study, a method for a single visit thyroid evaluation with the use of ^{123}I-NaI and the Anger camera, records the first transit of the radiotracer in the neck and measures the carotid thyroid transit time as an index of function which correlated well with other thyroid function tests. The validity of measuring ^{123}I-NaI transit as a means of evaluating thyroid function is discussed. (CH)

21444 (CONF-740708-5) COINCIDENCE COUNTING OF RADIOACTIVE SODIUM IN VIVO. Bauer, F. K.; Telfer, N.; Merrill, Q. (University of Southern California, Los Angeles (USA). Dept. of Medicine). 1968. 12p. (SM-185/21). Dep. NTIS (US Sales Only) $4.00.

From symposium on dynamic studies with radioisotopes in clinical medicine and research; Knoxville, Tennessee, USA (15 Jul 1974).

Changes in electrolyte distribution between extracellular and intracellular compartments are difficult to measure, since only human blood cells are easily sampled for measurement of intracellular constituents. The human ear cartilage, which is easily accessible, lends itself to the study of such phenomena in vivo. Cartilage has been shown to have high concentrations of cations. The total cation concentration per litre of cartilage water amounts to some 450 mEq/L. Ten μCi ^{22}Na, a positron emitter (physical half-life 2.6 years) were injected intravenously as sterile sodium chloride. Two detectors in coincidence fitted over one ear measured the amount of radioactivity passing through the ear repeatedly for the first hour and several times daily thereafter. Radioactivity of venous blood samples taken during this time was plotted against the buildup of radioactivity in the ear. Exchangeable sodium was also determined. With this method, subjects who had no evidence of disturbances of sodium or other electrolytes and patients with compensated and decompensated congestive heart failure, myocardial infarction in normal sodium balance, and patients with hypertension were studied. It was concluded that coincidence counting of the ear cartilage for positron-emitting radioisotopes has great potential for the study of extracellular and intracellular ion exchange in vivo, particularly in disturbances of sodium metabolism. (auth)

21445 (CONF-740708-6) STEADY STATE: A STANDARD CONDITION NEGLECTABLE OR COMPULSORY FOR RENAL FUNCTION STUDIES. Bongartz, W.; Kuni, H.; Ridder, H. W.; Naber, K. (Marburg Univ. (F. R. Germany)). 1972. 18p. (SM-185/55). Dep. NTIS (US Sales Only) $4.00.

From symposium on dynamics studies with radioisotopes in clinical medicine and research; Knoxville, Tennessee, USA (15 Jul 1974).

The so-called renal whole-body radioisotope clearance technique with decreasing blood level for the evaluation of kidney function is critically reviewed. It is pointed out that the application of the classic clearance formula in its differential mode is not fulfilled under routine conditions because of several errors, which are discussed. It is questioned whether the whole-body counting technique in renal clearance studies is to be judged as a clearance equivalent method. The development of a steady-state clearance procedure is described that uses a subcutaneous autogenous blood depot of EDTA-^{51}Cr. The quality of the blood level gained by this procedure is equivalent to that created by the continuous infusion technique. A further development of this method, total clearance calculated by means of a new and quantitative two-compartment analysis is described. Those conditions under which the main criterion of a steady state–input equal to output–is realized are discussed and it is shown that a constant blood level is a standard condition, neither sufficient in any case to prove a steady state nor absolutely necessary with regard to a mass balance. It is postulated that the conception seems to realize advantages evident in comparison to competitive procedures. (CH)

21446 (CONF-740708-7) RENAL FUNCTION STUDIES WITH RADIOISOTOPES: AN APPRAISAL. Britton, K. E. (Middlesex Hospital, London (UK). Inst. of Nuclear Medicine). 1974. 22p. (SM-185/65). Dep. NTIS (US Sales Only) $4.25.

From symposium on dynamics studies with radioisotopes in clinical medicine and research; Knoxville, Tennessee, USA (15 Jul 1974).

The use of radioisotopes in the diagnosis of renal disorders has grown out of the development of scintillation detectors and γ cameras and the availability of appropriate radioactive pharmaceuticals. What further information would the practicing nephrologist or urologist, physician, or surgeon like to know about patients' kidney function that is not easily obtainable by nonradioactive methods? He would like a simple and reliable measure of individual renal function; a test to demonstrate the presence or absence of obstruction in a patient with oliguria or uremia; some help as to whether nephrectomy or a more difficult restorative operation is better for the patient with hydronephrosis, calculus, or renal artery stenosis; a measure of the degree to which obstructive uropathy is causing obstructive nephropathy; clarification of which kidney to operate on first when bilateral obstructive nephropathy presents with uremia; a quantitative index of the progress following an operation to relieve an outflow system disorder; a screening procedure for renal disorders in the hypertensive and other populations; a prognostic guide to the likely evolution of glomerulonephritis and pyelonephritis, and a prediction of the onset of rejection in the renal transplant, particularly in the presence of acute tubular necrosis. This review attempts to define the extent to which renal function studies with radioisotopes

meet or fail to meet these needs and to indicate areas for potential development. (auth)

21447 (CONF-740708-9) QUANTITATIVE ANALYSIS OF HEPATOGRAMS USING THE GAMMA-CAMERA AND LABELED CONTRAST-MEDIUMS. Buttermann, G.; Wolf, I.; Pabst, H. W.; Hoer, G.; Schulze, P. E. (Technische Univ. Muenchen (F. R. Germany). Nuklearmedizinische Klinik und Poliklinik). 1974. 10p. (SM-185/5). Dep. NTIS (US Sales Only) $4.00.

From symposium on dynamics studies with radioisotopes in clinical medicine and research; Knoxville, Tennessee, USA (15 Jul 1974).

A method for the evaluation of time-activity-curves is described. The curves are obtained by a data-storage-system using the γ camera scintigrams after the intravenous injection of labeled contrast-mediums eliminated by the liver. The aim of the so-called hepatogram is to provide information on the functions of the liver (clearance and excretion), on the function of the gall bladder, and on the degree to which the extrahepatic gall-passage is blocked or unaffected. The examination was carried out on 170 patients, both those suffering from liver complaints and normal healthy individuals, mainly with ^{131}I-Ioglycamic-acid (^{131}I-Biligram). The calculations were based on a four-compartment-model (extra- and intravascular spaces, liver, and intraphepatic gall-ducts) including corrections for blood, tissue, and gallbladder background. By developing a program the computer is able to fit the theoretical results to the measured time-activity-curves. The measured hepatograms were compared with the calculated curves and single theoretical components were demonstrated. The summarized results of 70 clinically tested patients show the effectiveness of the method and the practicability of the model used. (auth)

21448 (CONF-740708-10) CLINICAL APPLICATION OF CEREBRAL DYNAMIC PERFUSION STUDIES. DeLand, F. H. (Florida Univ., Gainesville (USA); Veterans Administration Hospital, Gainesville, Fla. (USA)). 1971. 18p. (SM-185/40). Dep. NTIS (US Sales Only) $4.00.

From symposium on dynamics studies with radioisotopes in clinical medicine and research; Knoxville, Tennessee, USA (15 Jul 1974).

Radionuclide cerebral perfusion studies are assuming a far greater importance in the detection and differential diagnosis of cerebral lesions. Perfusion studies not only contribute to the differential diagnosis of lesions but in certain cases are the preferred methods by which more accurate clinical interpretations can be made. The characteristic blood flow of arterio-venous malformations readily differentiates this lesion from neoplasms. The decreased perfusion or absent perfusion observed in cerebral infarctions is diagnostic without concurrent evidence from static images. Changes in rates and direction of blood flow contribute fundamental information to the status of stenosis and vascular occlusion and in addition, offer valuable information on the competency and routes of collateral circulation. The degree of cerebral perfusion after cerebral vascular accidents appears to be directly related to patient recovery, particularly muscular function. Cerebral perfusion adds a new parameter in the diagnosis of subdural hematomas and concussion and in the differentiation of obscuring radioactivity from superficial trauma. Although pictorial displays of perfusion blood flow will offer information in most cerebral vascular problems, the addition of computer analysis better defines temporal relationships of regional blood flow, quantitative changes in flow and the detection of the more subtle increases or decreases in cerebral blood flow. The status of radionuclide cerebral perfusion studies has taken on an importance making it the primary modality for the diagnosis of cerebral lesions. (auth)

21449 (CONF-740708-12) DYNAMIC RENAL STUDIES IN THE EARLY POST-TRANSPLANT PERIOD. Dubovsky, E. V.; Logic, J. R.; Tauxe, W. N.; Diethelm, A. G.; Sterling, W. A. (Alabama Univ., Birmingham (USA)). 1974. 8p. (SM-185/49). Dep. NTIS (US Sales Only) $4.00.

From symposium on dynamics studies with radioisotopes in clinical medicine and research; Knoxville, Tennessee, USA (15 Jul 1974).

Results are reported from 223 examinations using ^{131}I-orthoiodohippurate and ^{99m}Tc-DTPA as tracers for perfusion and static scintigraphic studies on 75 renal transplant patients. Comprehensive evaluation of renal function consisted of a battery of tests performed three times in the immediate post-surgical period and repeated at approximately six month intervals. Radionuclide angiograms, orthoiodohippurate (OIH) scintigrams, and renographic curves, effective renal plasma flow (ERPF) values, and predicted and actual excreted amount of injected OIH, expressed as a percentage of the dose and corrected for the volume of residual urine in the bladder, were obtained. The ERPF was calculated from a single plasma sample drawn 44 minutes after injection of a standard amount of OIH and corrected for body surface area. The fraction of the injected dose which appeared in the urine at 35 minutes after injection (predicted on the basis of the observed value of ERPF) was then compared to the total actual excreted OIH. Excretion index (EI) was defined as the ratio of the actual to the predicted excretion percentage. The EI proved to be a very sensitive index of tubular function, and EI and ERPF were found valuable in predicted impending renal transplant rejection, return to normal after rejection, and acute tubular necrosis, while EI, along with sequential images, helped to differentiate incomplete obstruction from the hypotonic ureter syndrome often seen in the early post-surgical period. (auth)

21450 (CONF-740708-13) SHUNT DETECTION BY MEANS OF A GAMMA CAMERA AND COMPUTER. Goldberg, M. E.; Neal, W. A.; Loken, M. K.; Moller, J. H.; Ponto, R. A. (Minnesota Univ., Minneapolis (USA). Hospitals). 1974. 4p. (SM-185/93). Dep. NTIS (US Sales Only) $4.00.

From symposium on dynamics studies with radioisotopes in clinical medicine and research; Knoxville, Tennessee, USA (15 Jul 1974).

A group of 17 patients with left to right intracardiac shunts were studied, using ^{99m}Tc-pertechnetate (6 mCi per square meter) injected rapidly via a venous catheter. Flow patterns through the cardiopulmonary circulation were analyzed with aid of an Anger scintillation camera and a small dedicated computer. C_2/C_1 ratios were determined for the lung area. In the 17 patients with left to right shunts, average C_2/C_1 ratio was 0.50 with a range of 0.25 to 0.70. A group of 10 patients without shunts had an average C_2/C_1 ratio of 0.27, and a range of 0.20 to 0.37. (auth)

21451 (CONF-740708-14) DYNAMIC EVALUATION OF PERIPHERAL MUSCLE PERFUSION FOLLOWING VASCULAR SURGERY. Gerritsen, H. A.; Kazem, I.; Hasman, A.; Kuypers, P. J. (Katholieke Universiteit Nijmegen (Netherlands)). 1972. 9p. (SM-185/53). Dep. NTIS (US Sales Only) $4.00.

From symposium on dynamics studies with radioisotopes in clinical medicine and research; Knoxville, Tennessee, USA (15 Jul 1974).

A simple ^{99m}Tc-pertechnetate tracer technique for the evaluation of peripheral vascular disease is described. The typical normal scintigraphic pattern of the time-activity curve obtained in 24 normal subjects was compared to the pattern obtained in 72 patients with venous stasis. This last group was divided into 5 subgroups, depending on the arteriographical picture. The simple derivation of the parameters reported offers the advantage of comparing the local blood circulation pre- as well as post-operative. Related to the improvement of the peripheral muscle perfusion the results of vascular surgery can be evaluated. (auth)

21452 (CONF-740708-15) EXTRAVASCULAR LUNG WATER: ITS MEASUREMENT BY SIMULTANEOUS PULMONARY AND AORTIC SAMPLING AND ITERATIVE CONVOLUTION. Giuntini, C.; Fazio, F. (Pisa Univ. (Italy)). 1973. 17p. (SM-185/82). Dep. NTIS (US Sales Only) $4.00.

From symposium on dynamics studies with radioisotopes in clinical medicine and research; Knoxville, Tennessee, USA (15 Jul 1974).

A method is described for the measurement of the total lung water in patients with obvious clinical pulmonary edema. Tritiated water, THO, as diffusible indicator, and serum human albumin labeled with ^{131}I as intravascular tracer, were injected into the superior vena cava at the junction with the right atrium. In order to clear the aortic blood samples of recirculation, the recirculating tracers must be determined and this was accomplished by pulmonary artery sampling. Iterative convolution of the pulmonary artery dilution curves with suitable test functions yields, eventually, products of convolution that fit well the corresponding aortic dilution curves of the two tracers. The test functions that yield the best fit are taken to represent the frequency functions of the transit time from pulmonary artery to aorta of THO and ^{131}I, respectively. Applying the same procedure of iterative convolution to these frequency functions, the dilution curve of THO in the extravascular lung space was determined by computer calculations. The findings suggest the existence in the lungs of extravascular water pools slowly exchanging with pulmonary water flow. This may depend both on unevenness of perfusion, with lack of it at the limit, and on the distribution of the extravascular pulmonary water volume that may not be entirely adjacent to permeable branches of the pulmonary arterial system. (CH)

21453 (CONF-740708-17) PRODUCTION AND USE OF ^{81}Rb-^{81m}Kr FOR CLINICAL TISSUE PERFUSION MEASUREMENTS WITH THE ANGER CAMERA. Harper, P. V.; Rich, B.; Lathrop, K. A.; Mock, B. (Franklin McLean Memorial Research Inst., Chicago, Ill. (USA); Chicago Univ., Ill. (USA)). 1973. 17p. (SM-185/14). Dep. NTIS (US Sales Only) $4.00.

From symposium on dynamics studies with radioisotopes in clinical medicine and research; Knoxville, Tennessee, USA (15 Jul 1974).

It is clear from the results of experiments in baboons and human patients presented that the ^{81m}Kr-^{81}Rb method for measuring tissue perfusing with the Anger camera does not have the precision needed for clinical studies at the present stage of its development. The main difficulty lies in the correction for background, and in estimating a true value for the zero flow ratio. Fairly accurate relative numbers for flow are obtainable, however, in measurements requiring only a few minutes. The influence of various pharmacological interventions on these relative numbers might prove useful. In an experimental animal that can be sacrificed, good ^{81}Rb distribution values and background numbers, as well as measurements in the absence of flow, can be obtained at the conclusion of an experiment. In addition, the dissociation between the ^{81}Rb parent and ^{81m}Kr daughter seen most prominently in the lungs can be estimated by intravenous administration of ^{81m}Kr in solution. The fact that the clinical procedure is essentially noninvasive and that equivalent perfusion data can otherwise be obtained only by invasive means would appear to justify continued effort to perfect this approach. (auth)

21454 (CONF-740708-18) MEASUREMENT OF RED CELL LIFESPAN BY APPLICATION OF THE OCCUPANCY PRINCIPLE. Horton, P. W.; Hutcheon, A. W.; Dagg, J. H. (Western Regional Hospital Board, Glasgow (UK). Dept. of Clinical Physics and Bio-Engineering). 1974. 7p. (SM-185/64). Dep. NTIS (US Sales Only) $4.00.

From symposium on dynamics studies with radioisotopes in clinical medicine and research; Knoxville, Tennessee, USA (15 Jul 1974).

A new method of measuring red cell lifespan in vivo using radioiron is described. Plasma iron clearance and red cell utilization curves are followed after the intravenous injection of ^{59}Fe as for routine ferrokinetic measurements; determinations of stable iron in plasma and red cells are also made. Mean red cell lifespan and the flow rate of iron into erythropoiesis are determined from these data by applying the occupancy principle. Using this method, the mean red cell lifespan in eight normal subjects was found to be 115 days with a range 103 to 124 days. Fifteen patients with haemolytic anemias of differing severity were found to have shortened lifespans in the range 10 to 63 days. In 29 cases, ^{51}Cr red cell survival studies were carried out in addition to the present technique. A good correlation was obtained between red cell lifespan using the present method and ^{51}Cr red cell half disappearance time ($P < 0.001$). The total iron flow through the plasma derived by the occupancy principle is less than the conventional plasma iron transport rate. (auth)

21455 (CONF-740708-19) XENON VENTILATION AND PERFUSION STUDIES. Howard, B. Y. (Virginia Univ., Charlottesville (USA)). 1973. 13p. (SM-185/18). Dep. NTIS (US Sales Only) $4.00.

From symposium on dynamics studies with radioisotopes in clinical medicine and research; Knoxville, Tennessee, USA (15 Jul 1974).

Xenon-133 ventilation and perfusion techniques were developed to view pulmonary function dynamically. Background from previous studies and from the xenon given the patient can interfere with the visual and computer analysis of the data. A computer program was developed to subtract the various background contributions. The protocol for the studies, the computer program and the results are described. (auth)

21456 (CONF-740708-24) QUANTIFICATION OF CARDIAC VALVULAR REGURGITATION. Kirch, D. L.; Steele, P. P.; Metz, C. E.; Brown, D. W. (Colorado Univ., Denver (USA). Medical Center; Franklin McLean Memorial Research Inst., Chicago, Ill. (USA)). 1973. 19p. (SM-185/26). Dep. NTIS (US Sales Only) $4.00.

From symposium on dynamics studies with radioisotopes in clinical medicine and research; Knoxville, Tennessee, USA (15 Jul 1974).

The use of radionuclide tracers to perform high count rate dynamic studies of the heart has added new dimensions to the quantitation of valvular insufficiency. Using small volumes of concentrated radionuclide, it is now possible to introduce a bolus of radioactivity into the right or left atrium without performing arterial catheterization. An Anger camera interfaced to a dedicated minicomputer system, permits rapid accumulation, storage, and analysis of the data by the application of pulsatile modeling concepts for the determination of total, forward and regurgitant ejection fractions as well as the end-diastolic and end-systolic volumes of the atrium and ventricle. This paper describes the clinical methodology and results of the application of such a model to radionuclide angiocardiographic data, using ^{99m}Tc-pertechnetate as tracer. (auth)

21457 (CONF-740708-25) NON-INVASIVE DETERMINATION OF VOLUME EQUIVALENT CURVES OF THE LEFT VENTRICLE. Luig, H.; Emrich, D.; Breuel, H. P.; Strauer, B. E.; Neubaur, J. (Goettingen Univ. (F. R. Germany)). 1973. 8p. (SM-185/56). Dep. NTIS (US Sales Only) $4.00.

From symposium on dynamics studies with radioisotopes in clinical medicine and research; Knoxville, Tennessee, USA (15 Jul 1974).

A method of non-invasive determination of the volume curve of the left ventricle is described. A bolus of 10 mCi ^{99m}Tc-human-serum-albumin is injected intravenously. The count rate variation over the left ventricle is registered by a γ camera modified to provide high time resolution. The investigation is performed following homogeneous distribution of the tracer in the blood-volume. Because of the attendant low count rates, several hundred heart beats are recorded and their scintigrams are superposed. Only cycles of the most frequently observed duration are superposed forming the average representative heart cycle. The time-dependent integrals of counts over the left ventricle form the volume equivalent curve. From this curve a set of parameters characterizing the variation of volume in time is derived. In 52 cases investigated thus far, consisting of 17 controls and 35 patients with myocardial impairment, classified in different groups of impairment of the left ventricle, these parameters agreed with the pathophysiological conditions. Further investigations should prove the clinical value of this non-invasive and risk-free procedure, which can be performed on an out-patient basis. (auth)

21458 (CONF-740708-26) LOCALIZATION OF LEFT-TO-RIGHT SHUNTS BY RADIONUCLIDE ANGIOCARDIOGRAPHY (RAC). McIlmoyle, G.; Ahnberg, D.; LaFarge, G.; Treves, S. (Harvard Medical School, Boston, Mass. (USA)). 1974. 9p. (SM-185/81). Dep. NTIS (US Sales Only) $4.00.

From symposium on dynamics studies with radioisotopes in clinical medicine and research; Knoxville, Tennessee, USA (15 Jul 1974).

A safe, efficient, and relatively non-traumatic approach has been developed to the quantitation and localization of left-to-right intra- and extra-cardiac shunts. In patients with a small Qp:Qs cardiac catheterization and surgery may not be indicated, and the radioangiocardiography (RAC) may be repeated at intervals to follow the progress of the patient. It is also useful in assessing the results of surgical closure of left-to-right shunts (ASD, VSD, PDA). Twenty-eight patients were studied by RAC (3 to 30 years of age) using 200 μCi ^{99m}Tc-pertechnetate per kg of body weight injected intravenously preferably into the right jugular vein. The γ camera was interfaced with a digital computer system for acquisition, storage, and analysis of data. Uniqueness of the bolus of injectate and a quiet child were prerequisites for a satisfactory study. Twelve cases of VSD were localized accurately, three preoperatively and nine post-operatively with residual left-to-right shunt. Eight patients had shunts localized at the atrial level, and confirmed by cardiac catheterization and surgery. In one patient, valvular pulmonic stenosis was confirmed by absence of any left-to-right shunt whatsoever. Two patients had sufficiently specific streaming of the left-to-right shunt that the shunt was localized at the next downstream level. (auth)

21459 (CONF-740708-27) DECARBOXYLATION OF DL-DOPA STUDIED BY $^{14}CO_2$ ANALYSIS IN PARKINSONIAN AND MANGANIC PATIENTS. Mena, I.; Horiuchi, K. Z.; Court, J.; Lopez, G. (Harbor General Hospital, Torrance, Calif. (USA); Universidad Catolica de Chile, Santiago). 1973. 13p. (SM-185/2). Dep. NTIS (US Sales Only) $4.00.

From symposium on dynamics studies with radioisotopes in clinical medicine and research; Knoxville, Tennessee, USA (15 Jul 1974).

Total-body decarboxylation of dl-dopa ^{14}C and l-tyrosine ^{14}C inpatients was measured by continuous measurement of exhaled $^{14}CO_2$. A Talbert apparatus with an ionization chamber of 14.8 liters, connected to a vibrating reed electrometer and recorder, was used. Absolute calibration was accomplished by Ba $^{14}CO_3$ standards and the percentage of ^{14}C injected recovered as $^{14}CO_2$ was determined by planimetry of the curve recorded during one hour following injection of 2.5 to 8 uC of the labeled amino-acids. The radioactivity rise reached a maximum at 5 to 10 minutes and was followed by an exponential drop. At 24 hours after injecting radioactivity measurements were negative. Results are reported for patients studied, including 14 parkinsonians, 9 manganic patients, 6 healthy actively working miners, and 7 controls. (CH)

21460 (CONF-740708-28) ITERATIVE STUDY OF RENAL FUNCTIONS BY THE CONTINUOUS PERFUSION OF RADIOACTIVE TRACERS BEFORE AND AFTER THE INITIATION OF TREATMENT FOR SUGAR DIABETES AND HYPERTENSION. Mirouze, J.; Monnier, L.; Olivier, C. (Hopital Saint-Eloi, 34-Montpellier (France)). 1974. 5p. (In French). (SM-185/89). Dep. NTIS (US Sales Only) $4.00.

From symposium on dynamic studies with radioisotopes in clinical medicine and research; Knoxville, Tennessee, USA (15 Jul 1974).

Chronic renal insufficiency is a frequent complication in patients suffering from arterial hypertension and diabetes mellitus. The possible adverse effects of the long course of antihypertensive and antidiabetic drug therapy used for the treatment of these two conditions on kidney function were studied using intravenous perfusion of ^{125}I-iothalamate and ^{131}I-orthoiodohippurate for the simultaneous measurement of glomeruli filtration rate and renal clearance rate before the start of drug therapy and at various time intervals following initiation of drug therapy. Samples of blood plasma and urine collected three hours following the start of the perfusion were counted for radioactivity from the two tracers and were also analyzed for the clearance of nonradioactive tracers such as insulin; poly fructosan, and paraaminohippurate administered using the same perfusion technique as that used for the radioactive tracers. This method allows the evaluation of the effects of drug therapy on kidney function during the course of treatment. (CH)

21461 (CONF-740708-29) PULMONARY FUNCTION STUDIES WITH RADIOISOTOPES. Munkner, T. (Rigshospitalet, Copenhagen (Denmark)). 1974. 12p. (SM-185/104). Dep. NTIS (US Sales Only) $4.00.

From symposium on dynamics studies with radioisotopes in clinical medicine and research; Knoxville, Tennessee, USA (15 Jul 1974).

Physiological studies on lung ventilation and perfusion by means of labeled gasses (^{133}Xe) and radioactive flow tracers (^{131}I-albumin microspheres) have contributed essentially to our knowledge about the lung functions. Studies on patients with lung diseases, using the same techniques, have not attained the same importance, in part due to the fact that the necessary equipment is complicated and expensive. A number of physical and physiological factors have an influence on the results and make their interpretation more difficult than is usually recognized. If these problems can be solved, or at least evaluated to a reasonable extent, clinical studies on regional lung functions should become one of the major areas in nuclear medicine. (auth)

21462 (CONF-740708-30) ESTIMATION OF EFFECTIVE RENAL PLASMA FLOW IN CHILDREN BY MEANS OF A SINGLE INJECTION SINGLE SAMPLE TECHNIQUE. Tauxe, W. N.; Hagge, W.; Stickler, G. B. (Mayo Clinic, Rochester, Minn. (USA)). 1971. 7p. (SM-185/48). Dep. NTIS (US Sales Only) $4.00.

From symposium on dynamics studies with radioisotopes in clinical medicine and research; Knoxville, Tennessee, USA (15 Jul 1974).

A simple test for kidney function in pediatric patients is described that is based on estimates of effective renal plasma flow (ERPF) made following the intravenous injection of ^{131}I-orthoiodohippurate and counting of the radioactivity in blood plasma samples obtained from an indwelling needle at various time intervals. Equations for the calculation of ERPF are included. (CH)

21463 (CONF-740708-31) FUNCTIONAL IMAGES OF THE LUNGS. Natarajan, T. K.; Wagner, H. N. Jr. (Johns Hopkins Medical Institutions, Baltimore, Md. (USA)). 1974. 5p. (SM-185/15). Dep. NTIS (US Sales Only) $4.00.

From symposium on dynamics studies with radioisotopes in clinical medicine and research; Knoxville, Tennessee, USA (15 Jul 1974).

The objective of functional imaging is to portray in a single image, the relative function of various regions of an organ, or system of organs. The basic data on which such images are based are obtained from serial quantitative images of the organ's function (functions) obtained at various times after administering one or more radioactive tracers. Studies on the lungs were carried out using the scintillation camera and ^{133}Xe gas for measuring ventilation and a particulate agent such as ^{99m}Tc-labeled albumin microspheres for measuring regional perfusion. To measure regional ventilation, the patient was first allowed to breathe and equilibrate throughout his lungs ^{133}Xe from a spirometer; he was then allowed to breathe normally, room air which washes the ^{133}Xe from his lungs. During equilibrium and washout serial quantized image frames are recorded. To measure regional perfusion, the patient was administered ^{99m}Tc-albumin microspheres intravenously and a single image frame was recorded. From the serial images of the ^{133}Xe washout frames, after spatial averaging, a parameter proportional to the washout times was computed for each image cell element. These washout parameters were then used to construct a ventilation functional image. The spatial resolution of the study was adequate to provide structural as well as regional function information in a single image. The functional image provides an easily interpretable image of regional function that would be difficult to interpret if presented to the physician in the form of a mass of numerical data, or as a time sequence of multiple serial images. The functional image contains in one image, all the information from the time serial images representing the washout of the radioactive gas. The ventilation and perfusion images can be combined in a single image by using color. Use of color is quite effective in viewing multiple functions and their spatial relations in the same image. (auth)

21464 (CONF-740708-32) STUDY OF THE POST-EQUILIBRIUM SLOPE APPROXIMATION IN THE CALCULATION OF GLOMERULAR FILTRATION RATE USING THE ^{51}Cr-EDTA SINGLE INJECTION TECHNIQUE. Nimmon, C. C.; McAlister, J. M.; Hickson, B.; Cattell, W. R. (Saint Bartholomew's Hospital, London (UK)). 1972. 7p. (SM-185/11). Dep. NTIS (US Sales Only) $4.00.

From symposium on dynamics studies with radioisotopes in clinical medicine and research; Knoxville, Tennessee, USA (15 Jul 1974).

A comparison of methods for calculating the renal clearance of ^{51}Cr-EDTA from the plasma disappearance curve, following a single injection, was developed. Measurements were made on 38 patients, using external scanning and venous blood sampling techniques, over a period of 24 h following an injection of 100 μCi of ^{51}Cr-EDTA. The results indicate that the period 3 to 6 h after injection is suitable for sampling the post-equilibrium part of the plasma disappearance curves for values of the glomerular filtration rate (GFR) in the range 0 to 140 ml/min. It was also found that, to within the individual measurement errors, the values of the clearance calculated by using the post-equilibrium period only (PES clearance) can be considered to show a constant proportionality to the values calculated by using the entire plasma disappearance curve (total clearance). (auth)

21465 (CONF-740708-33) MULTILATERAL EVALUATION OF RENAL TRANSPLANTS WITH RADIONUCLIDES. Pavel, D. G.; Kahan, B. D.; Quinn, J. L. III; Bergan, J. J.; Westerman, B. R. (Northwestern Univ., Chicago, Ill. (USA)). 1974. 14p. (SM-185/29). Dep. NTIS (US Sales Only) $4.00.

From symposium on dynamics studies with radioisotopes in clinical medicine and research; Knoxville, Tennessee, USA (15 Jul 1974).

The radionuclide study of a transplanted kidney should be approached in a multilateral fashion. A single parameter, a single type of display (images or curves), or a single radiopharmaceutical does not provide enough diagnostic information. Methods using ^{99m}Tc-DTPA and ^{131}I-hippuran as tracers and computer processing of γ camera scintiphotos are described. In ATN the diagnosis, severity, and prognosis were readily determined by the multilateral approach. Collecting system abnormalities were accurately revealed by the technique, and the potential development of a leak was often suspected before it was evident on the intravenous pyelogram. In diagnosis of rejection although the usefulness of the radionuclide studies is beyond doubt, a word of caution seems appropriate. We have not seen a clear cut situation where the radionuclide tests suggested rejection before there were changes in the chemical and clinical data. When the immunologic tests could be performed, they were able to predict the possibility of rejection sometimes more than one week in advance. Nevertheless the fact that radionuclide tests can confirm rejection and can rule out other factors such as obstruction is of considerable value in patient management. Indeed so many considerations bear upon the decision whether or not to treat or to re-explore, that any concordant or discordant pieces of information are particularly useful. This is true not only for the first weeks after transplantation but also for the long range follow-up. One other potential aid in patient management is the follow-up of recovery from a rejection episode. Preliminary observations suggest that only when there is a clear cut improvement of the Hippuran and DTPA curves can complete recovery be considered or superimposed factors be ruled out. (auth)

21466 (CONF-740708-35) DATA PROCESSING OF RADIONUCLIDE CEREBRAL ANGIOGRAMS IN THE DIFFERENTIAL DIAGNOSIS OF INTRACRANIAL DISEASE. Preissig, R. S.; Witherspoon, L. R.; Tyson, J. W.; Harris, C. C.; Goodrich, J. K. (Duke Univ., Durham, N. C. (USA). Medical Center). 1974. 12p. (SM-185/37). Dep. NTIS (US Sales Only) $4.00.

From symposium on dynamics studies with radioisotopes in clinical medicine and research; Knoxville, Tennessee, USA (15 Jul 1974).

Variation in region-of-interest analysis of cerebral hemispheric activity following intravenous injection of ^{99m}Tc-pertechnetate was defined for a normal population. Application of these normal values permitted objective classification of observed patterns of hemispheric radionuclide activity distribution in anaplastic

gliomas, cerebrovascular disease, and arteriovenous malformations. Radionuclide distribution in gliomas in non-specific, but delay in time-to-peak activity is rarely observed. In cerebrovascular disease the affected hemisphere usually demonstrates decreased activity, often associated with a delay in time-to-peak activity. Arteriovenous malformations show a characteristic, but not pathognomic, marked increase in activity followed by a marked decline. The increased detection of abnormalities using this analysis and its usefulness in assisting differentiation of these three entities is demonstrated. (auth)

21467 (CONF-740708-36) DYNAMIC STUDIES OF LIVER AND THYROID FUNCTION WITH THE AID OF A GAMMA CAMERA AND AN ON-LINE DIGITAL COMPUTER. Raikar, U. R.; Ganatra, R. D.; Samuel, A. M.; Ramanathan, P.; Atmaram, S. H. (Bhabha Atomic Research Centre, Bombay (India). Radiation Medicine Centre). 1974. 25p. (SM-185/78). Dep. NTIS (US Sales Only) $4.25.

From symposium on dynamics studies with radioisotopes in clinical medicine and research; Knoxville, Tennessee, USA (15 Jul 1974).

Initial experience of dynamic radioisotope studies with the use of a 16 K digital computer coupled to a scintillation camera is described. A system for scoring the injected bolus was developed taking into account peaking time, the ratio of counts at the peak, and at 8 seconds after the peak and full width at half maximum. Various parameters affecting the boli are discussed. A method was developed for finding the slope of net early trapping of $^{99m}TcO4$ in the thyroid after subtraction of extrathyroidal vascular background. This value was found diagnostically useful in establishing the state of thyroid function in 23 patients. Portal extraction time ($T\frac{1}{2}$) of various colloidal radiopharmaceuticals was studied in the first two minute dynamic study of the liver and ^{113m}In colloid had the shortest trapping $T\frac{1}{2}$. This determination provided a method of bioassay for the consistency of the production of colloid for liver scintigraphy. Difference was noted in the trapping time between the right and left lobe of the liver. On the basis of portal extraction half times ^{99m}Tc phytate appeared to form colloid instantaneously after injection into the circulation and its behavior on dynamic studies was more or less identical with that of the ^{99m}Tc-S-colloid. Normal liver has a dual blood supply, while a malignancy in the liver derives blood only from the hepatic artery. Benign lesions like an abscess or a cyst are relatively avascular. This difference in the blood supply of benign and malignant space occupying lesions in the liver was exploited in an early dynamic study of blood flow to offer a clue to the pathology of the cold area observed in 170 patients. (auth)

21468 (CONF-740708-37) METHOD FOR INVESTIGATION REGIONAL VARIATIONS OF THE CEREBRAL UPTAKE RATE OF ^{11}C LABELLED PSYCHOTROPIC DRUGS IN MAN. Raynaud, C.; Todd-Pokropek, A. E.; Comar, D.; Pizer, S. M.; Kacperek, A.; Maziere, M.; Marazano, C.; Kellershohn, C. (CEA, 91-Orsay (France). Service Hospitalier Frederic Joliot; University Coll. Hospital Medical School, London (UK)). 1974. 22p. (SM-185/84). Dep. NTIS (US Sales Only) $4.25.

From symposium on dynamics studies with radioisotopes in clinical medicine and research; Knoxville, Tennessee, USA (15 Jul 1974).

A pilot study of the uptake of ^{11}C labeled psychotropic drugs in man was undertaken. Functional images, being plots of uptake rate as a function of position were obtained for both patients and phantoms and compared to time activity curves produced for selected regions of interest. Good correspondence was observed. Three cases of the uptake of ^{11}C-chlorpromazine, three cases of ^{11}C-imipramine, and two cases of ^{11}C-diazepam were studied. The functional images gave useful results far more rapidly than the use of regions of interest. In particular rapid early uptake in the frontal region of the brain was observed in several cases. The preliminary results indicate that the technique described is of considerable value in such studies. (auth)

21469 (CONF-740708-38) MODEL FOR THE ANALYSIS OF RADIOCARDIOGRAMS USING A DIGITAL COMPUTER IN TIME-SHARING MODE. Riihimaeki, E.; Heiskanen, A.; Heiskanen, T.; Taehti, E. (Helsinki Univ. Central Hospital (Finland). Meilahti Clinic). 1974. 7p. (SM-185/75). Dep. NTIS (US Sales Only) $4.00.

From symposium on dynamics studies with radioisotopes in clinical medicine and research; Knoxville, Tennessee, USA (15 Jul 1974).

A model is presented to evaluate the volumes of a series of pulsating compartments of the heart by ^{113m}In dilution technique. The model is applied to the analysis of time-activity curves derived from serial images recorded with a γ camera. The analysis is performed with a digital computer in time-sharing mode through a demand terminal. Results of normal subjects are presented. The separation of the atrial and ventricular volumes was not successful, but the right heart and left heart blood volumes agreed rather well with previous findings. (auth)

21470 (CONF-740708-40) COMPUTER ANALYSIS OF REGIONAL CEREBRAL PERFUSION: A CRITICAL CLINICAL ANALYSIS. Ronai, P. M.; O'Reilly, R. J.; Collins, P. J. (Institute of Medical and Veterinary Science, Adelaide (Australia). Div. of Nuclear Medicine). 1974. 16p. (SM-185/9). Dep. NTIS (US Sales Only) $4.00.

From symposium on dynamics studies with radioisotopes in clinical medicine and research; Knoxville, Tennessee, USA (15 Jul 1974).

An advanced computer program was developed for the analysis of regional cerebral perfusion data obtained by the scintillation camera during ^{99m}Tc-pertechnetate cerebral radioangiography. The program evaluates and corrects detector non-uniformity; selects (using statistical criteria) three regions-of-interest (ROIs) corresponding with the distribution of the left and right middle cerebral arteries and both anterior cerebral arteries; measures the areas of the ROIs and plots total corrected counts per unit ROI area per unit time against time for each ROI. The significance of differences in perfusion between ROIs is assessed and related to a normal population distribution. A critical clinical evaluation of this program was undertaken on 686 patients who had cerebral radioangiograms during 1970 and 1971. Final diagnoses were determined from case records after a follow-up period of two years or more. Original digital data were reprocessed and original analogue dynamic scintiphotos were re-reported without knowledge of the clinical data or digital results. Analogue reports were compared with the results of digital analysis using two different statistical methods to analyse the digital results. Neither method of digital analysis gave any increase in the yield of true positive findings while one method of analysis substantially increased the yield of false positive findings. It is suggested that observer training in the detection of minor analogue abnormalities and the fastidious control of detector non-uniformity in this laboratory contributed to the negative result of this study. An alternative interpretation is that these two factors allowed the accuracy of analogue reports to be improved to match the accuracy of digital analysis. (auth)

21471 (CONF-740708-42) RADIOCARDIOGRAPHY OF MINIMAL TRANSIT TIMES: A USEFUL DIAGNOSTIC PROCEDURE. Schicha, H.; Vyska, K.; Becker, V.; Feinendegen, L. E. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Medizin). 1974. 11p. (SM-185/54). Dep. NTIS (US Sales Only) $4.00.

From symposium on dynamics studies with radioisotopes in clinical medicine and research; Knoxville, Tennessee, USA (15 Jul 1974).

Contrary to the situation with mean transit times, minimal transit times are defined by the differences between arrival times of an indicator transported with the blood through consecutive compartments. Arrival times in various cardiac compartments can be easily measured with radioisotopes and fast gamma cameras permitting selection of regions of interest from which time activity curves are to be obtained. Minimal cardiac transit times (MTTs) were measured preferentially with a γ camera following pulse-injection of ^{113m}In-DTPA in normal individuals and patients with various cardiac diseases, through the right auricle, right ventricle, through the lung, left auricle, and left ventricle (segmental MTTs); the difference of arrival times in right auricle and aortic root is called total MTT. Results showed that minimal cardiac transit times are diagnostically useful as sensitive, quantitative parameters for myocardial function; they also help to localize valvular disease. For routine cardiac evaluation it is not necessary to determine separate absolute cardiac volumes but their relationships. MTTs corrected for heart rate are expressions of these relationships. (auth)

21472 (CONF-740708-44) DETECTION OF RENAL ARTERY STENOSIS IN HYPERTENSIVE PATIENTS USING THE SCINTILLATION CAMERA AND SMALL COMPUTER. Shames, D. M.; Farmer, R. E. L.; Rollo, F. D. (California Univ., San Francisco (USA). Dept. of Radiology). 1974. 11p. (SM-185/51). Dep. NTIS (US Sales Only) $4.00.

From symposium on dynamics studies with radioisotopes in clinical medicine and research; Knoxville, Tennessee, USA (15 Jul 1974).

A technique was developed to measure relative renal blood flow between the two kidneys. Following intravenous injection of ^{99m}Tc-gluconate, first-pass radioactivity versus time curves (2 to 4 points per second) were obtained over each kidney using the scintillation camera interfaced to a dedicated digital computer. Data analysis, employing fundamental principles of dye-dilution theory, was performed only on the first five seconds of

the curves following appearance of radioactivity in the kidneys. The rapidity and ease with which the data can be collected and analyzed offers significant advantages over other techniques, which use ^{131}I-hippurate and require large off-site digital computers for analysis. (auth)

21473 (CONF-740708-45) REGIONAL MYOCARDIAL PERFUSION STUDIES: A CRITIQUE OF DATA COLLECTION AND PROCESSING TECHNIQUES. Stokely, E. M.; Parkey, R. W.; Bonte, F. J. (Texas Univ., Dallas (USA)). 1974. 15p. (SM-185/36. Dep. NTIS (US Sales Only) $4.00.

From symposium on dynamics studies with radioisotopes in clinical medicine and research; Knoxville, Tennessee, USA (15 Jul 1974).

The effect on the calculated regional blood perfusion rate of several variations in the collection of myocardial clearance data using inert diffusible, nonpolar gas tracers is discussed. Experimental results using ^{133}Xe curves from mongrel dogs suggest that to maintain errors of 10% or less in computed perfusion values, a temporal quantization interval (frame time) of 10 s or less should be employed. Studies using regions of interest of various sizes indicate that significant spatial flow gradients exist in infarcted myocardia, and that the smallest possible area of interest should be used which is compatible with good counting statistics and instrument resolution. Routine subtraction of background from the myocardial curve is suggested, since failure to perform this correction resulted in a 16% error in perfusion rates. A multicompartment analysis of the ^{133}Xe clearance curve before and after infarction showed a consistent shift in the predominance of the second compartment following infarction. This result and the findings of others led to the development of a new model for computing perfusion rates from myocardial clearance data. The new model is based on a diffusion-limited heterogeneous microstructure in the myocardium for inert, nonpolar gases. (auth)

21474 (CONF-740708-47) TIME-ACTIVITY CURVE ANALYSIS FOR DYNAMIC LUNG STUDY. Taehti, E.; Riihimaeki, E.; Aaltonen, S.; Korhola, O. (Helsinki Univ. Central Hospital (Finland). Meilahti Clinic). 1974. 9p. (SM-185-74). Dep. NTIS (US Sales Only) $4.00.

From symposium on dynamics studies with radioisotopes in clinical medicine and research; Knoxville, Tennessee, USA (15 Jul 1974).

Basic measurable quantities in a dynamic lung study performed with ^{133}Xe tracer gas are regional distributions of air volume, fractional exchange of air, and blood flow. A simple procedure to extract approximations to these quantities from the regional time-activity curves is described. A patent presentation of results allows left to right comparisons to be made. Quantitative judgment of the extent of the abnormalities is also possible. (auth)

21475 (CONF-740708-49) METABOLISM OF ^{111}In-TRANSFERRIN AS A MEASURE OF BONE MARROW ACTIVITY. Touya, J. J.; Anselmi, O. E.; Riley, R. F.; Bennett, L. R. (California Univ., Los Angeles (USA)). 1974. Contract AT(04-1)-GEN-12. 24p. (SM-185/20). Dep. NTIS (US Sales Only) $4.25.

From symposium on dynamics studies with radioisotopes in clinical medicine and research; Knoxville, Tennessee, USA (15 Jul 1974).

The use of ^{111}In-transferrin as a bone marrow scintigraphic agent was studied in comparison with the use of ^{59}Fe-transferrin in rats and in 60 patients with different types of hematological disorders. For the first stage of the investigation, the intestinal absorption of ^{111}In and ^{59}Fe was studied in rats. The indium absorption was 0.27% ± 0.12 (S.D.) of the administered dose, however, the amount of iron absorbed, under the same conditions, was 49.52% ± 23.84. It was concluded from these experiments that indium could not use the intestinal non-ferritin pathway. It was concluded that it could not be used to study iron gastrointestinal absorption in humans. The half-time for plasma clearance of indium transferrin was 5.78h ± 0.70 in rats. Patients with reduced iron binding capacity had faster plasma clearances of indium than was expected from their blood cell production. They also had increased renal excretion of indium and the kidneys appeared darker than normally seen on scans. In rats, indium was excreted faster than iron. Of the administered indium, 28.8% was excreted with a half-time of 48 hours and the remainder of the dose, 71.2%, with a half-time of 57.2 days. All of the iron was excreted with a half-time of 89.2 days. Only 1.36% ± 0.12 of the administered indium was incorporated into the red blood cells in rats and after the fourth day, the indium RBC incorporation curve declined. In humans, the ^{111}In RBC incorporation was ten times smaller than the ^{59}Fe RBC incorporation. In rats, the organ distribution of indium and the distribution of the iron of the iron labile pool and iron stores had a correlation coefficient of 0.8103. The differences occurred in liver, skin, and muscles. Patients with generalized or localized diminution of erythropoietic bone marrow production showed generalized or localized decrease of accumulation of ^{111}In in bone marrow. Patients with increased bone marrow production showed increased bone marrow accumulation and expansion of radioactive areas to the epiphysis, and in some cases, to the shafts of the bones of the extremities. Patients with hemosiderosis showed ^{111}In accumulation in the regions of the bone marrow that had very poor red cell production but had increased deposits of iron. (auth)

21476 (CONF-740708-53) ^{123}I-INDOCYANINE GREEN (^{123}I-ICG) AS AN AGENT FOR DYNAMIC STUDIES OF THE HEPATO BILIARY SYSTEM. Ansari, A. N.; Atkins, H. L.; Lambrecht, R. M.; Redvanly, C. S.; Wolf, A. P. (Brookhaven National Lab., Upton, N. Y. (USA)). 1974. 21p. (SM-185/61). Dep. NTIS $4.25.

From symposium on dynamics studies with radioisotopes in clinical medicine and research; Knoxville, Tennessee, USA (15 Jul 1974).

Indocyanine green is exclusively extracted by hepatic polygonal cells and is excreted entirely in bile. It has no significant enterohepatic circulation. These properties make indocyanine green a suitable agent for estimating liver function. Indocyanine green is commercially available and contains small amounts of sodium iodide. Development of a method to remove the sodium iodide adulterant allowed efficient labeling of the indocyanine green with ^{123}I. A preliminary report is presented of the distribution of ^{123}I-labeled indocyanine green in mice and dogs. Computer generated dynamic curves were obtained in rabbits. Serial scintiphotos were taken in normal and common bile duct obstructed dogs. Preliminary data indicates the feasibility of ^{123}I-indocyanine green as a radiopharmaceutical agent for dynamic studies of the hepatobiliary system. (auth)

21477 (CONF-740708-54) CONTINUOUS REGISTRATION OF THE THYROIDAL UPTAKE OF ^{99m}Tc AND ^{123}I IN THE FIRST 30 MINUTES. Atkins, H. L.; Lambrecht, R. M.; Ansari, A. N.; Bradley-Moore, P. R.; Wolf, A. P. (Brookhaven National Lab., Upton, N. Y. (USA)). 1973. 19p. (SM-185/46). Dep. NTIS $4.00.

From symposium on dynamic studies with radioisotopes in clinical medicine and research; Knoxville, Tennessee, USA (15 Jul 1974).

The continuous registration of the thyroidal uptake of intravenously administered sodium pertechnetate-^{99m}Tc and sodium iodide-^{123}I was performed in the same patients on consecutive days by γ camera scintiscanning. Recording was for 30 minutes and a comparison was made of the uptake at 20 minutes and of the curves of thyroidal concentration of radioactivity during the thirty minute period. In euthyroid patients the mean uptake ± standard deviation was 1.21 ± 0.66% for technetium and 2.48 ± 1.49% for iodine. This ratio of approximately 2.5, I/Tc, was obtained both for the euthyroid and hyperthyroid groups. However, individual patients showed a wide range of I/Tc ratios with 7 patients having a ratio less than 1.0. Analysis of the shape of the curves was not helpful in that no consistent patterns were obtained associated with specific clinical conditions. It was concluded that the pertechnetate uptake is related to, but not a specific measure of, the iodide trap. (auth)

21478 (CONF-740708-55) DETERMINATION OF CORONARY BLOOD FLOW WITH ^{84}Rb AND POSITRON CAMERA. Chwojnik, A.; Fedchteyn, S.; Garcia del Rio, H.; Pecorini, V.; Giuntini, C. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). [nd]. 7p. (SM-185/1). Dep. NTIS (US Sales Only) ?4.00.

From symposium on dynamic studies with radioisotopes in clinical medicine and research; Knoxville, Tennessee, USA (15 Jul 1974).

The measurement of coronary blood flow in man by means of radioisotopes and external counting techniques has been attempted by several investigators. Various isotopes have been administered either by single bolus or by constant infusion. Results are reported using ^{84}Rb (a positron emitter) and a positron camera to measure the coronary blood flow. In this technique approximately 100 μCi of ^{84}Rb is injected rapidly into an antecubital vein and all the data recorded by the camera on the passage of the material through the heart and surrounding structures are stored on magnetic tape. The counting rate of the injected dose is measured in situ and then by applying Sapirstein's relationship, the total myocardial blood flow (MBF) can be derived by determining the fraction of the injected dose deposited in the myocardium and multiplying it by the cardiac output. The application of this method for measurements of MBF provides exact identification and selection of the heart area and isoefficiency of the myocardium counting conditions, and allows for the contribution of intravascular activity. Clinical trials were performed on

a group of normal subjects and on a group of patients. The results indicate that this technique is useful in evaluating myocardial blood flow and as a screening test for changes of MBF in various pathological conditions. (auth)

21479 (CONF-740708-56) MEASUREMENT OF TEMPORAL CHANGES IN WHOLE-BODY RADIONUCLIDE DISTRIBUTION WITH A PROFILE SCANNER. Gibbs, W. D.; Edwards, C. L.; Hodges, H. D.; Cloutier, R. J. (Oak Ridge Associated Universities, Inc., Tenn. (USA). Medical Div.). 1974. 19p. (SM-185/63). Dep. NTIS $4.00.

From symposium on dynamic studies with radioisotopes in clinical medicine and research; Knoxville, Tennessee, USA (15 Jul 1974).

A linear scanner was instrumented to acquire data in digital form that are entered easily into a computer for quantitative analysis of linear distribution of activity and whole-body retention of radionuclides. The instrumentation consists of an external amplifier, a single-channel analyzer, a multichannel analyzer operated in multiscale mode, and paper tape punch. When a scan table speed of 8 in/min (other speeds are available) and analyzer timing of 3 sec/channel (also variable) are used, a total-body linear scan requires 10 minutes and 200 channels of analyzer memory. Each channel thus represents about 1 cm of body length. A camera attached to the multichannel analyzer oscilloscope provides a record of the linear scan. The linear scan data stored in the multichannel analyzer is transferred to paper tape. With information on patient identification, anatomic landmarks, etc, the scan data are entered into the computer and stored on magnetic tape. The computer analysis program calculates the amount of activity in the whole-body and the fraction of activity in each of eight sections of the body defined by the landmarks. The program also can be used to compare the results with earlier scans and calculate changes of distribution with time. (auth)

21480 (CONF-740708-58) RADIOPHARMACEUTICALS FOR FUNCTION STUDIES: PRESENT AND FUTURE. Poggenburg, J. K.; Hayes, R. L. (Oak Ridge National Lab., Tenn. (USA); Oak Ridge Associated Universities, Inc., Tenn. (USA). Medical Div.). 1974. 14p. (SM-185/62). Dep. NTIS $4.00.

From symposium on dynamic studies with radioisotopes in clinical medicine and research; Knoxville, Tennessee, USA (15 Jul 1974).

Present radiopharmaceutical agent techniques in function studies are reviewed and future developments in this field are postulated. Rapid and slow function studies each have their own demands and accordingly are treated separately. Advances in instrumentation and computational techniques, coupled with new production capabilities now coming into existence, can be expected to play important roles. Potassium-43 appears to have particular promise as a myocardial scanning agent. Iodine-123 and ^{97}Ru will undoubtedly find increasing use, and short half-life positron emitters and spallation-produced radionuclides should find increased use in dynamic studies in nuclear medicine and in clinical research applications. (auth)

21481 (CONF-740708-59) DATA HANDLING SYSTEMS FOR USE IN DYNAMIC FUNCTION STUDIES. Brill, A. B. (Vanderbilt Univ., Nashville, Tenn. (USA). Div. of Nuclear Medicine and Biophysics). 1974. 8p. (SM-185/101). Dep. NTIS (US Sales Only) $4.00.

From symposium on dynamic studies with radioisotopes in clinical medicine and research; Knoxville, Tennessee, USA (15 Jul 1974).

Radioactive tracers initially were used in nuclear medicine to measure slowly changing biological functions. As improved tracers and instruments were developed, more rapidly changing biological functions were measured in routine medical practice. Traditional studies with analog devices provide good information on patterns of system behavior, but more attention is being directed to the extraction of numerical parameters with which to differentiate normal from diseased subjects. The data handling systems developed for use in nuclear medicine have been adapted from physics systems. These are useful for the collection and analysis of data from nuclear medicine dynamic function studies. The types of systems and configurations that are currently being used in routine and research applications are reviewed. The choice of a system depends on a number of factors, especially the types of studies to be performed. The discussion includes an introduction to computer terminology, the types of systems used with different sensors, and display devices, and a brief review of problems involved in the use of computers in nuclear medicine. (auth)

21482 (CONF-740708-60) CARDIAC FUNCTION STUDIES WITH RADIOISOTOPES. Giuntini, C. (Pisa Univ. (Italy)). 1973. 18p. (SM-185/103). Dep. NTIS (US Sales Only) $4.00.

From symposium on dynamic studies with radioisotopes in clinical medicine and research; Knoxville, Tennessee, USA (15 Jul 1974).

In order to measure the blood turnover time or the volume of the heart cavities by selective counting of radionuclides, it is necessary to define the time-activity curve of each cardiac chamber. This may be accomplished by a highly selective choice of areas of interest with imaging cameras. However, this approach is severely limited by unevenness of blood mixing in the atria and ventricles. With isoefficient counting it appears possible to estimate the ratio of the combined volumes of the right and left cardiac chambers. Employing this counting method with imaging cameras it might be possible to estimate the volume ratio between any two heart cavities and if the volume of one cavity is known to estimate the volume of each cavity. Of the parameters useful to evaluate the cardiac function, the only one that has been shown that can be determined with sufficient accuracy in man and dogs is the mean pulmonary circulation time. On the other hand, the ability of the mean pulmonary circulation time to assess the functional heart capacity, especially that of the left heart, has been tested in a large number of subjects. (CH)

21483 (CONF-740708-62) REGIONAL BLOOD FLOW STUDIES WITH RADIOISOTOPES. Holman, B. L.; McNeil, B. J.; Adelstein, S. J. (Harvard Medical School, Boston, Mass. (USA); Peter Bent Brigham Hospital, Boston, Mass. (USA)). 1974. 19p. (SM-185/102). Dep. NTIS (US Sales Only) $4.00.

From symposium on dynamic studies with radioisotopes in clinical medicine and research; Knoxville, Tennessee, USA (15 Jul 1974).

The methodologic approaches to blood flow analysis include diffusible indicator methods, clearance techniques, and nondiffusible indicator methods. In each case, accurate measurements of blood flow can be obtained by developing mathematical models which relate the time dependent observation derived from following the fate of a radiotracer as a function of time to the physiologic process itself. Application of these models to biological systems involves constraints and necessitates compromises which may affect the validity of the measurements. Nevertheless, when these techniques are carefully applied and adequately validated, they have provided critical physiological information about such organ systems as the brain and kidney and promise to provide diagnostic information in patients with suspected coronary and peripheral vascular disease. (auth)

21484 (CONF-740708-63) NUMERICAL ANALYSIS OF DATA IN DYNAMIC FUNCTION STUDIES. Riihimaki, E. (Helsinki Univ. Central Hospital (Finland). Meilahti Clinic). 1974. 11p. (SM-185/100). Dep. NTIS (US Sales Only) $4.00.

From symposium on dynamic studies with radioisotopes in clinical medicine and research; Knoxville, Tennessee, USA (15 Jul 1974).

The relations between tracer theories, models for organ function, and numerical solution of parameters from tracer experiments reviewed. A unified presentation is given in terms of systems theory. Dynamic tracer studies should yield as end results flows and volumes of the tracee and possibly indications of internal structure of the organ studied. Proper program writing will facilitate the exchange of the application programs between the users to avoid duplication of effort. One important point in this respect is machine independence of the programs by the use of a high level language. (auth)

21485 (CONF-740708-64) CONTINUOUS MEASUREMENTS, BY TWO ISOTOPES, OF EXTRAVASCULAR LUNG WATER: USE OF A NEW METHOD IN THE ANALYSIS OF PULMONARY CAPILLARY RECRUITMENT AND FILTRATION IN NORMAL MAN. Ruff, F.; Even, P.; Duroux, P.; Caubarrere, I.; de Vernejoul, P.; Nicolas, R. L.; Brouet, G. (Hopital Necker-Enfants-Malades, 75-Paris (France); Hopital Laennec, 75-Paris (France). Clinique de Pneumo-Phtisiologie). 1972. 16p. (In French). (SM-185/90). Dep. NTIS (US Sales Only) $4.00.

From symposium on dynamic studies with radioisotopes in clinical medicine and research; Knoxville, Tennessee, USA (15 Jul 1974).

Measurement of pulmonary interstitial fluid may be useful in clinical medicine for early diagnosis or measurement of interstitial and/or alveolar pulmonary edema. A modification of the double dilution radionuclide scanning method of Chinard and Goresky is proposed. Compared to previous methods, this technique, using two gamma emitters, is rapid, simple, reproducible and may be repeated. The values obtained in normal subjects at rest, 3.5 ± 0.5 ml/kg, are comparable with those of other authors. They increase considerably in cases of fluid load. (auth)

21486 (INIS-MF-1168-2, pp vp, 11p) USE OF RADIOISOTOPES IN MEDICAL DIAGNOSIS. Riihimaeki, E. 1973.

From Finnish summer school in nuclear physics; Liperi, Finland (11 June 1973).

Imaging and function studies using radioisotopes are discussed. Imaging devices, image processing, and dynamic studies are de-

scribed. The advantages of short-lived isotopes are considered. (MCG)

21487 (LBL-2491) ANALOG AND DIGITAL SIMULATION OF THE RADIOCARDIOGRAM. Parker, H. G.; Van Dyke, D. C.; Upham, F. T.; Windsor, A. A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jun 1974. Contract W-7405-eng-48. 23p. (CONF-740708-57; SM-185/23). Dep. NTIS $4.25.

From symposium on dynamics studies with radioisotopes in clinical medicine and research; Knoxville, Tennessee, USA (15 Jul 1974).

A mathematical model of the radiocardiogram was developed to deal with the pulsatile component of the tracing. It is applicable to the bedside radiocardiogram, radionuclide angiocardiographic studies with the scintillation camera, or description of other tracer studies in the central circulation. The model consists of four heart chambers, each ejecting a fixed fraction of its contained tracer with each systole, and a lung delay function. Discrete-variable calculation of end-systolic and end-diastolic tracer content of the heart chambers and lung allowed development of simple, rapid programs for simulation by small digital computers. By this means, curve fitting and estimation of ejection fractions, end-diastolic volumes, and mean lung delay may eventually be automated. A better understanding of the problems of extracting diagnostically useful information from such a multi-parameter fit should result from study of these simulations. Families of characteristic curves were generated for several disorders where pattern recognition as well as parameter estimation is important. A small, light weight, portable electronic analog simulator has been developed to permit the same simulation and trial-and-error parameter estimation at the bedside. It puts a real-time tracing onto the chart recorder used for actual radiocardiograms. Its design features are described. Some ideas unifying analog and digital modeling are expressed in differential equations. They provide a framework for future simulation of the radiocardiogram in the irregularly beating heart and an algorithm for potential extraction of detailed chamber-volume curves from the nonequilibrium portion of the radiocardiogram. (auth)

21488 CEREBRAL HEMATOMA WITH INTRAVENTRICULAR BLEEDING. Silver, L.; Sham, R.; Klein, H. A. (Queens Hospital Center, Jamaica, NY). J. Nucl. Med.; 15: No. 7, 639-640(Jul 1974).

The extensive use of brain scanning as an initial diagnostic procedure in evaluating the patient with a cerebrovascular accident has been a source of interesting interpretive exercises and of unusual results arising from the abnormal pathologic physiology. Such an instance is exemplified by a case report in which a brain scan was performed using a γ camera and injection of ^{99m}Tc-DTPA. At postmortem examination, there was a large hematoma of the right cerebral hemisphere destroying portions of the basal ganglia. (auth)

21489 CELLULAR NECROSIS MODEL IN TISSUE CULTURE: UPTAKE OF ^{99m}Tc-TETRACYCLINE AND THE PERTECHNETATE ION. Dewanjee, M. K.; Prince, E. W. (Harvard Medical School, Boston). J. Nucl. Med.; 15: No. 7, 577-581(Jul 1974).

The recent development of ^{99m}Tc-tetracycline and its successful use in delineating myocardial infarcts encouraged further investigation into the mechanism of its uptake and its localization on a subcellular level. The affinity of ^{99m}Tc for cells and subcellular constituents when incubated with ^{99m}Tc-tetracycline was evaluated in tissue culture. Live cells obtained from exponentially growing cultures or dead cells obtained from the media of nutritionally depleted plateau-phase cultures were incubated with ^{99m}Tc-tetracycline at 37°C for various times. After incubation, the cells were washed and the total cellular activity as well as the subcellular localization of ^{99m}Tc determined. About 60 times more ^{99m}Tc remained associated with the dead cells than with the live cells. This affinity was not seen when the dead cells were incubated with the pertechnetate ion. On the subcellular level, at least 50% of the ^{99m}Tc appeared to be associated with the DNA and protein fractions of the cell. This system may provide a rapid and economical means of screening radioactive compounds currently being prepared to detect necrotic tissue. (auth)

21490 PEPTIDASE ACTIVITY OF CARRIER PROTEINS USED IN RADIOIMMUNOASSAYS. Rutner, H.; Gutcho, S.; Johnson, J.; Dodd, T. (Swartz/Mann Div. of Becton, Dickinson, and Co., Orangeburg, NY). J. Nucl. Med.; 15: No. 7, 557-560(Jul 1974).

Preparations of lysozyme, bovine serum albumin, and human serum albumin may contain levels of peptidases affecting the stability of angiotensin I and ^{125}I-angiotensin I ($Asp^1.Ile^5$), the standard and tracer in the radioimmunoassay of angiotensin I using plasma renin activity kits. Enzyme activity was evaluated by a radioimmunoassay method measuring the loss of immunoreactivity of angiotensin and an autoradiographic method permitting a quantitation and characterization of fragments of angiotensin. Damage ranged from very slight to extensive and was consistent with chymotrypsin or chymotrypsin-like activity. Evaluation of carrier proteins used in radioimmunoassays is essential for long-term stability of peptides. (auth)

21491 POSITIVE BRAIN SCAN IN TOXOPLASMOSIS. Puri, S.; Spencer, R. P.; Gordon, M. E. (Yale Univ., New Haven). J. Nucl. Med.; 15: No. 7, 641-642(Jul 1974).

A newborn baby with hydrocephalus had a positive ^{99m}Tc-pertechnetate brain scan. The area of uptake corresponded to a granular infiltrating lesion caused by congenital toxoplasmosis. A search of prior brain scans revealed two in which positive scans were seen in adults with evidence of toxoplasmosis, but a cause and effect relationship was not clear. (auth)

21492 RADIOALLERGOSORBENT TEST WITH A PURIFIED ALLERGEN FROM CODFISH. Aas, K. (Univ. of Oslo); Lundkvist, U. Clin. Allergy; 3: 255-261(1973).

The radioallergosorbent test (RAST) was performed with a purified allergen (DS 22) from cod, coupled to CNBr-activated cellulose discs. A 100% correlation was found between a positive RAST and the presence of clinical allergy to cod in fifty-six children as compared to a negative RAST in all sera from fifty-six allergic children tolerating fish. Positive results were obtained with discs treated with DS 22 in a concentration as low as 0.4 ng/ml. (auth)

21493 DIRECT RADIOIMMUNOASSAY OF PLASMA CEA. Bartorelli, A. (Univ., Milan); Accinni, R.; Golferini, A.; Mistretta, A. P.; Tassi, G. C.; De Barbieri, A.; Mor, C.; Leonetti, G.; Orefice, S.; Rocco, F. Boll. Inst. Sieroterap. Milan.; 52: 333-345(1973).

A technique for the direct radioimmunoassay of plasma CEA is described. The method with a sensitivity of 78 picograms exploits the principle of the double antibody for the separation of the immunocomplex from the free antigen. A case-list of 493 subjects, 83 of whom blood donors and 410 suffering from different pathological conditions, was employed to substantiate the reliability of the technique. The non-adenocarcinomatous positive cases of the digestive tract are 1.7% and the false-negative 9.5%. (auth)

21494 DATA SMOOTHING OF NUMERICAL SCINTIGRAMS. Martin, J. (UER de Sciences Medicales, Nancy); Portmann, M. C. (UER de Sciences Medicales, Nancy). Int. J. Nucl. Med. Biol.; 1: 45-49(1973). (In French).

Many methods of treatment of numerical scintigrams begin with data smoothing, whatever the ultimate analysis may be. This initial smoothing attempts to eliminate random variations in the count while losing the fewest possible valid items of information linked to the volume measures. Practically no study has been carried out on the validity of these methods, and it is difficult to conceive a satisfactory theoretical approach. Results are reported from an empirical test by data processor, by simulation, and by analyzing a scintigram of a liver phantom following the administration of a tracer dose of ^{85}Sr. The methods of data smoothing by successive means, and of different methods by approximation by least squares are discussed. (auth)

21495 PHARMACEUTICAL PREPARATION FROM ^{99m}Tc-LABELLED MACROAGGREGATED HUMAN SERUM ALBUMIN. Winchell, H. S.; Barak, M.; van Fleet, P. III. (to Medi-Physics, Inc., Emeryville, Calif. (USA)). German Patent 2329168/A/. 3 Jan 1974. 7p. (In German).

The invention refers to a method for preparing ^{99m}Tc-labelled macroaggregated human serum albumin (HSA). The main feature of the preparation is the particle size between 10 and 90 μm, which is suitable for lung scintigraphy. This is made possible by means of complexation of the HSA-macroaggregate with Sn(II) from a colloidal Sn(II) chloride solution. (GE)

21496 AUTORADIOGRAPHIC IN VITRO INVESTIGATIONS ON PROSTATIC TISSUE WITH THE C-14- UND H-3-THYMIDINE DOUBLE-LABELING METHOD. Helpap, B.; Stiens, R. (Bonn Univ. (F. R. Germany). Pathologisches Inst.); Bruehl, P. (Bonn Univ. (F. R. Germany). Urologische Klinik). Beitr. Pathol.; 151: No. 1, 65-74(1974). (In German).

2 figs.; 31 refs.

The knowledge of cell kinetics is a necessary prerequisite for cell-cycle specific treatment with cytostatic drugs and x rays. In vitro autoradiographic studies were performed to investigate the proliferative activity of normal, hyperplastic, and malignant prostatic tissue. Biopsies of normal and neoplastic prostatic tissue were incubated first for one hour in autologous plasma with ^{14}C-thymidine and, following this, for one or two hours with ^{3}H-thymidine. In the autoradiograms the labeling index of the epithelial cells of the prostatic tissue was measured and the duration of the DNA-synthesis time was estimated from the proportion of doubly labeled cells (^{14}C and ^{3}H)

to singly labeled cells (only ^{3}H or ^{14}C). The labeling indices were low (0.01-0.6%) in normal, atrophic, and hyperplastic prostatic tissue. Well differentiated adenocarcinomas showed a labeling index of 0.4 to 1.9%, whereas in anaplastic tumors and poorly differentiated adenocarcinomas a labeling index of 1.1 to 3.8% was measured. The DNA-synthesis phase had an average duration of 8 hours in the prostatic carcinomas. These results correlate with the well known clinical and morphological features of prostatic carcinomas indicating very low proliferative activity. (auth)

21497 ^{125}I-LABELED NEUTROTOXIN FROM CLOSTRIDIUM BOTULINUM A. Preparation, Binding to Synaptosomes and Ascent to the Spinal Cord. Habermann, E. (Giessen Univ. (F. R. Germany). Pharmakologisches Inst.). Naunyn-Schmiedebergs Arch. Pharmakol.; 281: No. 1, 47-56(1974).

4 figs.; 2 tabs.; 14 refs.

Labeling of crystalline botulinum A toxin was done with ^{125}I by aid of the chloramine T method. The neurotoxic component is well preserved, whereas the hemagglutinin undergoes physicochemical alterations. Neurotoxin, homogeneous in gel filtration, is bound to synaptosomes from rat brain. Cold toxin competes with labeled toxin, and antitoxin or neuraminidase partially remove the bound neurotoxin. Upon intramuscular injection, some radioactivity is recovered in the respective parts of the spinal cord. Antitoxin prevents the ascent. The similarities between tetanus and botulinum A neurotoxins are stressed. (auth)

21498 HETEROGENEOUS TISSUE MODEL FOR MEASUREMENT OF REGIONAL BLOOD PERFUSION IN MYOCARDIUM USING INERT GAS ISOTOPES. Stokely, E. M. (Southern Methodist Univ., Dallas); Nardizzi, L. R.; Parkey, R. W.; Bonte, F. J. Math. Biosci.; 20: No. 3/4, 359-380(Aug 1974).

Inert gas isotopes are finding increasing application in the measurement of blood perfusion in the capillary beds of muscle, especially the myocardium. When measuring blood perfusion of the myocardium, washout curves are first produced by precardial monitoring of isotope activity following intracoronary artery injection of an inert gas isotope dissolved in saline. The washout curve data are then applied to a mathematical model to yield blood perfusion rate. Present models for this purpose either ignore any diffusive effects of gas movement (Kety-Schmidt model), or diffusive effects are accounted for by weighting the calculated perfusion value (Zierler's height-over-area). (auth)

21499 RADIOIMMUNOASSAYS OF 3,4,5-TRIMETHOXYPHENETHYLAMINE (MESCALINE) AND 2,5-DIMETHOXY-4-METHYLPHENYLISOPROPYLAMINE(DOM). Riceberg, L. J.; Van Vunakis H.; Levine, L. (Brandeis Univ., Waltham, MA). Anal. Biochem.; 60: No. 2, 551-559(Aug 1974).

Mescaline (3,4,5-trimethoxyphenethylamine) and N-succinylmescaline were coupled to human serum albumin with carbodiimide. DOM (2,5-dimethoxy-4-methylphenylisopropylamine) was linked to human serum albumin by reaction with glutaraldehyde. These conjugates were used for immunization of rabbits. Derivatives of mescaline [N-(3',4',5'-trimethoxy-phenethyl)-4-hydroxyphenylacetamide] and of DOM [N-(2'5'-dimethoxy-4'-methylphenylisopropyl)-4-hydroxyphenylacetamide], which could be iodinated to high specific activity, were synthesized. The antibodies bound specifically to these iodinated compounds. In competition experiments with a mescaline antiserum, 6 pmoles of mescaline inhibited 50%; with a DOM antiserum, 50% inhibition was observed with 118 pmoles of DOM. Thus, 100 pg of mescaline and 2 ng of DOM can be detected. The specificity of both antibodies is such that structurally related molecules, such as p-methoxy-phenethylamine or 3-methoxytyramine, are several orders of magnitude less effective as inhibitors than the parent molecules. With the use of anti-mescaline, it was determined that mescaline administered intravenously to rabbits disappeared rapidly from the circulation. The acid was identified as the major metabolite in the serum and urine of these animals. (auth)

21500 RADIOIMMUNOASSAY FOR PLASMA TESTOSTERONE. Hosaka, M.; Konno, M.; Nishimura, R. (Yokohama Univ., Japan). Yokohama Igaku; 24: No. 1, 47-53(Feb 1973). (In Japanese).

Nearly complete separation of dihydrotestosterone from testosterone for the radioimmunoassay of plasma testosterone is developed. A simple method for the determination of testosterone is described. The antiserum against testosterone-3-oxime-bovine serum albumin is supplied by Department of Pharmacological Research, Teikoku Hormone Mfg. Co., Ltd. and is used at a dilution of 1 : 20,000. Plasma volume of 0.05 ml from men and 0.5 ml from women are used for analysis. The method involves extraction with ether and chromatography on Sephadex LH-20 with the solvent system hexane : benzene : methanol (80 : 15 : 5). Only 1.5 ± 0.5 (S.D.)% dihydrotestosterone is present in the testosterone fraction. Following elution, the dried purified extract is incubated with antiserum at room temperature for 30 minutes. $(NH_4)_2SO_4$ is used to separate free from bound testosterone. The accuracy and precision of the method are satisfactory. The mean blank is 9 ± 5 (S.D.) pg per sample. The mean recovery of testosterone-^{3}H added to 21 plasma samples is 67.7 ± 4.7 (S.D.)%. The concentration of testosterone in plasma from men is 568 ± 200 (S.D.) mμg/dl and in sample collected from women is 30 ± 14 mμg/dl. The mean and range of plasma testosterone concentrations in normal men and women determined by this method are similar to those reported by other investigators using different methods. (auth)

21501 DETERMINATION OF PROGESTERONE IN HUMAN PLASMA BY RADIOIMMUNOASSAY. Calabresi, E.; Pazzagli, M.; Fiorelli, G.; Forti, G.; Serio, M. (Univ., Florence). J. Nucl. Biol. Med.; 18: No. 1, 30-37(1974).

A radioimmunoassay for the determination of progesterone in human plasma is described. After extraction from plasma with n-hexane, progesterone is separated by Sephadex LH 20 chromatography. The radioimmunoassay is performed using an antiserum to 11α-hydroxyprogesterone-11-hemisuccinate-RSA and dextran-coated charcoal. Precision, accuracy, sensitivity, and specificity have been evaluated. The mean level of progesterone in normal men and normal women during follicular and luteal phase is reported. (auth)

21502 SERUM ALBUMIN TURNOVER IN LIVER CIRRHOSIS. Bianchi, R. (Univ., Pisa, Italy); Mariani, G.; Pilo, A.; Toni, M. G. J. Nucl. Biol. Med.; 18: No. 1, 20-29(1974).

This paper reports 21 observations on albumin catabolism and distribution performed by the radioiodinated protein in 19 cirrhotic patients, in 3 of which albumin synthesis was independently measured by ^{14}C-carbonate technique; in one patient the study was performed three times, at different time intervals. Turnover results indicate a nearly normal intravascular albumin mass (despite the lowered serum albumin concentration) thanks to the enlarged plasma volume in ascitic patients. Extravascular albumin mass was markedly reduced in patients with ascites, thus showing in them a marked depletion of intracellular albumin stores. Catabolism also was decreased in cirrhotics with ascites, being more correlated to the extravascular albumin than to the total body albumin pool. Significant correlation between metabolic results and the commonly used liver function tests was found only in respect of plasma prothrombin content and serum glutamic oxalacetic transaminase with the absolute catabolic rate of albumin and the ratio extra- to intravascular albumin pool respectively. (auth)

21503 ANATOMICAL AND FUNCTIONAL PICTURES OF ACUTE HOT THYROID NODES AND THE RELATIONSHIPS BETWEEN THIS FORM AND ENDEMIC GOITRE. Gubetta, L.; Cottino, F.; Costa, A. (Mauriziano Hospital, Turin). J. Nucl. Biol. Med.; 18: No. 1, 13-19(1974).

A further series of 38 cases of goiter with acute onset in the form of inhibiting hot node observed in endemic areas is reported. The iodine metabolism picture is described, together with the histological findings in 8 cases; the latter were not substantially different in either sporadic or endemic, nodose or diffuse, acute goiter and endemic goiter. It is considered that these findings justify the retention of a single concept with respect to endemic goiter. (auth)

21504 BLOOD TRANSPORT IN PULMONARY CIRCULATION SIMULATED BY A DIGITAL COMPUTER. Pavia, M.; Adam, W. E. (Univ., Brussels). J. Nucl. Biol. Med.; 18: No. 1, 1-12 (1974).

We have built a simulator of the pulmonary circulation, as a Fortran programme, which will permit the analysis of a classical experiment in Nuclear Medicine. This concerns the instantaneous injection of an albumin-^{99m}Tc bolus into the right atrium and the study of the radioisotope transport from the right to the left heart. We have individualized the different elements which cause the dispersion of the radioisotope. The role played by each parameter of the model is studied separately. (auth)

21505 SENSITIVE RADIOIMMUNOASSAY FOR COLLAGEN. Adelmann, B. C.; Gentner, G. J.; Hopper, K. (Max-Planck-Institut fuer Biochemie, Munich). J. Immunol. Methods; 3: 319-336(1973).

A sensitive radioimmunoassay for collagen antibodies is presented. The assay also provides information on the class of antibodies and their avidity. Antibody to collagen raised in guinea-pigs is reacted with ^{125}I-labelled collagen of various species. The reaction product is precipitated with antiserum to guinea-pig globulins obtained from rabbits or goats. A factor, present in normal sera of various species and capable of discriminating between native and denatured collagen, is described. (auth)

21506 CLINICAL STUDIES ON LIVER-SPLEEN SCINTIGRAM WITH THE USE OF ^{131}I-MICROAGGREGATED ALBU-

MIN. Nakagawa, S.; Fujiyama, S. (Kumamoto Univ., Japan). Kaku Igaku; 11: No. 2, 71-85(Apr 1974). (In Japanese).

The clinical usefulness and significance of the liver-spleen scintigram was studied using ^{131}I-microaggregated albumin (^{131}I-MIAA). Twenty-four patients with liver diseases and splenomegaly were examined. By the external counting over the liver and spleen, half times of radioactivity disappearance were about 5 hours or more. The spleen images were visualized on all cases. On 13 cases in those patients, two kinds of scintiscannings using ^{131}I-MIAA and ^{198}Au-colloid were examined within 2 weeks. Those two scintigrams were compared in regards to the size of the spleen image, the grade of uptake of the spleen image (Castell's splenic score), patchy pattern of the liver image, the sharpness of the margin of the liver image, bone marrow image, and background. The information about the spleen image was more significant in the ^{131}I-MIAA scintigram, but the liver image was not as good. The Castell's splenic score was correlated with the durations of the liver diseases and, especially, the grade of portal hypertension. The correlation of the splenic score, however, with various liver function tests and peripheral blood findings was not so clear. On some cases with acute hepatitis (convalescent stage) and hemolytic anemia, the spleen images with ^{131}I-MIAA were more remarkable than the other, which were scarcely visualized. (auth)

MATERIALS

21507 (WASH-1181-74) MATERIALS SCIENCES PROGRAMS, FY 1974. (USAEC Division of Physical Research, Washington, D. C.). Jul 1974. 99p. Dep. NTIS $8.00.

A compilation and index of the AEC Materials Science Program is presented. The report is divided into sections containing information on projects in progress at individual laboratories, and funding levels. An index of investigators, materials, phenomena, techniques and environment is also included. (JRD)

21508 COMPOSITE MATERIALS: TESTING AND DESIGN. Third Conference Held in Williamsburg, Virginia, March 21-22, 1973. ASTM Special Technical Publication 546. Philadelphia; American Society for Testing and Materials (1974). 684p. (ASTM-STP-546; CONF-730331-). $39.75.

Papers are presented on testing fabrication, uses, and performance of composite materials. The papers are grouped in sections on testing methods, analytical treatments, experimental studies, environmental effects, fatigue and fracture behavior, wear properties, and aircraft applications. (JRD)

Ceramics and Cermets

Refer also to abstracts 20692, 21583, 21587, 21588, 21591, 21595, 21619, 21647, 21652, 21660, 21665, 21674, 21737, 21821, 21829, 21831, 21832, 23099, 23107, and 23149.

21509 (AREAEE-184) PRELIMINARY STUDIES OF VACUUM SINTERING OF UO_2. Haroun, N. A.; El-Adham, K. A. (Atomic Energy Establishment, Cairo (Egypt)). 1973. 13p. Dep. NTIS (U. S. Sales Only) $4.00.

The sintering of UO_2 powder compacts at 900 to 1600°C for 1 to 4 h in vacuum was investigated. Densities much higher than those usually obtained were always reached. The results were attributed to the high sinterability of the powder employed. Variable bloating effects were noted particularly at higher temperatures. Densities in excess of 1 h at 900°C were obtained and densities of the order 99% were reached after 2 h sintering. The technical importance of the findings was discussed, and directions of further improvement were suggested. (auth)

21510 (BDX-613-1173) CHARACTERIZATION OF A CHROME-GOLD THIN FILM DEPOSITION PROCESS BY AUGER ANALYSIS. Clay, F. A. (Bendix Corp., Kansas City, Mo. (USA)). Aug 1974. Contract AT(29-1)-613. 18p. Dep. NTIS $4.00.

A chromium-gold thin film deposited onto tantalum-nitride-coated aluminum oxide substrates was investigated in terms of deposition parameters, electrical resistivity, adhesion, and thermocompression bondability. Thermocompression bondability was acceptable for all films in the as-deposited condition; was marginal to unacceptable for stabilized films; and was (again) acceptable for films which had been chemically etched after stabilizing. Auger Electron Spectroscopy was used to correlate degraded bondability with the presence of a chromium oxide contaminant formed on the gold bonding surface as a result of thermal stabilization. Production process parameters were established. (auth)

21511 (CONF-730591-) REPORT ON THE TOPICAL CONFERENCE ON NUCLEAR FUEL 73, CHICAGO, ILLINOIS, MAY 22-25, 1973. Dutton, J. (comp.). (Atomic Industrial Forum, Inc., New York (USA)). 1973. 58p.

Papers presented at the conference on fuel supply, fuel management, fuel recycle, and fuel financing are included in the report. (JRD)

21512 (COO-1198-1081) ELECTRON MICROSCOPY STUDY OF CARBIDE PRECIPITATION IN A VANADIUM-TITANIUM ALLOY. Fluhr, C. P. (Illinois Univ., Urbana (USA)). May 1974. Contract AT(11-1)-1198. 106p. Dep. NTIS $8.50.

Thesis.

Investigation results show that the precipitation of carbon from supersaturated solid solution in vanadium-titanium alloy occurs in at least two stages: an incoherent $(V,Ti)_2C$ precipitate and an ordered superstructure $(V,Ti)_1C$. The incoherent $(V,Ti)_2C$ precipitate is hexagonal and the orientation relationship with the matrix may be expressed: (00.1) hcp/(011) cubic, [$\bar{1}$1.0] hcp/[11$\bar{1}$] cubic. The misfit between the incoherent carbide and the matrix gives rise to internal faulting in the carbide. The formation of shear structure is possible. The precipitation of the ordered superstructure occurs on {100} habit planes and the plate-shaped particles are no more than 200 Å thick. (auth)

21513 (DP-MS-73-71) SORPTION OF TRITIUM BY NICKEL DURING PLASTIC DEFORMATION. Donovan, J. A. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). [nd]. Contract AT(07-2)-1. 19p. (CONF-740535-1). Dep. NTIS $4.00.

From meeting of the AIME; Pittsburgh, Pennsylvania, USA (19 May 1974).

The effect of plastic deformation on the amount of tritium absorbed, the surface concentration, and the apparent diffusivity was determined by comparing elastically and plastically deformed sections of nickel tensile tubes that were filled with tritium during deformation. Plastic deformation increased the amount of tritium absorbed by the metal and adsorbed on the surface, but decreased the apparent diffusivity. These observed data for nickel can be explained by the trapping theory developed for iron; where the dislocations created during deformation are postulated to trap the tritium, thereby producing higher values for interior and surface tritium concentrations, and lower values for tritium diffusivity. (auth)

21514 (DPST-74-128-5) ^{238}Pu FUEL FORM PROCESSES. Savannah River Laboratory Monthly Report. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). May 1974. Contract AT(07-2)-1. 32p. Dep. NTIS $4.75.

Comparative ball-milling tests of $^{238}PuO_2$ in air and argon indicated the desirability of providing an argon atmosphere for all future ball-milling operations in the Alpha Materials Facility. Fabrication of additional $^{238}PuO_2$ pellets confirmed the adequacy of the LASL prescribed process for PPO fuel forms. Hot-pressed pellets of $^{238}PuO_2$ were found to contain impurities that are believed to be flakes of silver solder from sieve screens. A program was initiated to provide the information necessary for encapsulation of $^{238}PuO_2$ in iridium shells. (auth)

21515 (EUR-5066) IRRADIATION OF PLUTONIUM FUELED COATED PARTICLES IN FRJ 2. Baier, J.; Bairiot, H.; Vangeel, J.; Van Sinay, R. (Commission of the European Communities, Luxembourg; Hochtemperatur-Reaktorbau G.m.b.H., Mannheim (F. R. Germany); Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany)). Feb 1974. 86p. Dep. NTIS (US Sales Only) $7.50. EUR B.Fr. 125.-.

Two types of plutonium oxide fueled carbon coated particles in diluted 550 μm-kernels and dense 250 μm-kernels were irradiated for 45.4 full power days in FRJ 2 (Jülich) at about 1100°C. A burnup of about 18% fissions per initial metal atom (FIMA) and a fast dose of less than 10^{20} n/cm^{-2} DNE were accumulated. Postirradiation fission gas measurement results indicated that no particle was broken. The metallographic examinations show different behavior of the inner pyrocarbon layers due to different plutonium migration into buffer layers during the coating process. Only small plutonium migration during irradiation could be found which has been stopped by the SiC layer. (auth)

21516 (EURFNR-1180) METALLOGRAPHY OF URANIUM CARBIDES AND URANIUM-PLUTONIUM MIXED CARBIDES. Ghosh, J. K.; Vollath, D. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Material- und Festkoerperforschung). Mar 1974. 20p. (KFK-1976). Dep. NTIS (U. S. Sales Only) $4.00.

Work performed under United States-Euratom Fast Reactor Exchange Program.

Results of a survey are presented on the status of the literature on the metallography of uranium carbides and uranium-plutonium-carbides. Work on phase identification in different carbide fuels is reported. In addition, some hints for the metallographic preparation of carbide fuel are given. (auth)

21517 (GEPP-126) SYSTEM FOR DEPOSITION AND HYDRIDING OF THIN METALLIC FILMS WITHOUT AIR EXPOSURE. Eichman, C. C.; Comeau, J. L.; Rinehuls, K. R. (General Electric Co., St. Petersburg, Fla. (USA). Neutron Devices Dept.). [nd]. Contract AT(29-2)-656. 17p. Dep. NTIS $4.00.

A non-air exposed hydriding/deposition system provides advanced processing capability for hydriding erbium thin films. The system is designed with precise controls for cold crucible electron beam deposition of erbium, film deposition monitoring, and temperature bakeout. Using a mechanical transfer device, a complete hydriding process for erbium deposited films can be completed without air exposure. The system offers many processing improvements such as the ability to make gas analyses during various phases of the processing (with the capability of isolating the analyzer tube when not is use), and isolation of the ion pumps from hydriding gases and atmospheric pressure. A major processing benefit is the capability to vacuum bake and

hydride gas process the hydriding fixture before the disk substrates are transferred into the hydriding chamber. (auth)

21518 (INIS-mf-1235) ELECTRICAL IRRADIATION EFFECTS IN SOLID DIELECTRICS. An Annotated Bibliography. Gross, P. (Sao Paulo Univ., Sao Carlos (Brazil). Instituto de Fisica e Quimica). 1973. 207p. INIS.

The bibliography lists in alpha-numerical order, by the name of the first author, about 800 papers on electron irradiation effects in solid dielectrics. Nearly all entries contain short abstracts. An introductory section gives a short review of the subject matter. Then follows a list of contents and a subject index; the latter lists the same topics, each followed by the entry numbers of the papers relevant to the subject. The bibliography covers papers and reports published until June 1973. (INIS)

21519 (KFK-1485) DTA MEASUREMENTS IN THE URANIUM–NITROGEN SYSTEM. Holleck, H.; Ishii, T. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Material und Festkoerperforschung). Aug 1972. 13p. (AED-Conf-71-247-1).

From third international conference on thermal analysis; Davos, Switzerland (23 Aug 1971).

Differential thermal analysis (DTA) measurements were carried out to obtain additional data on the phase relations in the U–N system. The nitrogen decomposition pressure of β-U_2N_3 and $UN_{1.5z}O_{2(1-z)}$ ($0 < = z < = 1$) as well as the equilibrium nitrogen pressure for the reaction from β- to α-U_2N_3 was measured as a function of temperature. 1) The temperature dependence of the equilibrium nitrogen pressure for the reaction 2 UN + (1-x)/2 N_2 reversible to β-U_2N_{3-x}, measured by DTA, showed a fairly good agreement with the results obtained by other methods and is expressed by the equation: $\log P_{N2}$ (atm) = $6.361 - 10.649 \times 10^3/T$ (1450 to 1600°K) i.e., UN transforms to β-U_2N_3 at 1390°C and 1 atm N_2. 2) The reaction temperature from β- to α-U_2N_3 was examined at various nitrogen pressures. The equilibrium nitrogen pressure for the reaction β-U_2N_{3-x} + $\frac{1}{2}(x+y)N_2 \rightarrow \alpha$-$U_2N_{3+y}$ is: $\log P_{N2}$ (atm) = $6.131 - 8.115 \times 10^3/T$ (1145 to 1325°K) i.e., β-U_2N_3 transforms to α-U_2N_3 at 1050°C and 1 atm N_2. 3) When oxygen is dissolved in the α-phase, the nitrogen decomposition pressure of $UN_{1.5z}O_{2(1-z)}$ to β-U_2N_3 (in the case of low oxygen content), or to UN (high oxygen content) becomes lower than that of pure α-U_2N_3. Such a reduction of the nitrogen potential can be useful to suppress the fuel–cladding interaction in a nitride fuel element at high burn-up. (GE)

21520 (KFK-1952) DESIGN, IRRADIATION, AND POST IRRADIATION EXAMINATION OF THE UO_2/PuO_2 FUEL PIN IRRADIATION EXPERIMENTS OF THE FR 2 CAPSULE GROUP NO. 4b. Weimar, P.; Dippel, T.; Freund, D. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Material- und Festkoerperforschung). Mar 1974. 278p. (In German). Dep. NTIS (US Sales Only) $17.00.

Irradiation of 35 fuel pin samples containing UO_2-PuO_2 fuel in the thermal flux of the Karlsruhe research reactor FR 2, represents a further testing of the SNR basic fuel pin concept. The irradiation has been carried out in 11 Na/PbBi double-capsules, where 3 or 4 samples are stacked one above the other. The fuel column of 80 mm length consists of pellets with a Pu-content of 20 wt %. Two different fuel densities of 84 and 90% T. D., corresponding to smeared densities of 80 and 85% T. D., have been realized. The austenitic stainless steel claddings have an outer diameter of 6.0 mm with a wall thickness of 0.38 mm. The total length of the fuel pin is 172 mm. The capsules have been irradiated at normal fuel element or isotope canal positions. At linear rod powers up to 620 W/cm and clad surface temperatures 770°C maximum; the burnup lies between 10 and 120 MWd/kg metal. The samples have been irradiated between 46.2 and 517.5 days full power (44 MW) equivalent. All fuel pins are intact. A compilation of design, specification, and fabrication as well as a detailed description of irradiation and post irradiation examination results are given. (auth)

21521 (KFK-1953) REACTION BEHAVIOR OF FISSION PRODUCTS IN CARBIDE AND NITRIDE FUEL BASED ON SIMULATED FUEL COMPOSITIONS. Smailos, E. (Kernforschungszentrum Karlsruhe (F. R. Germany)). Mar 1974. 171p. (In German). Dep. NTIS (U. S. Sales Only) $11.75.

The reaction behavior of the important solid fission products was experimentally investigated in nitride and carbide fuels. In the nitride fuel, the quasibinary mononitride systems UN–ZrN, UN–YN, UN–LaN, UN–CeN, UN–PrN, and UN–NdN show that UN exhibits complete solid solubility at high temperatures (1800 to 2000°C) with ZrN and rare earth metal nitrides. Based on these results and thermodynamic stability data, fission product reactions in mixed nitride fuel (U, Pu)N at high burn up are deduced. The consequences of the reaction behavior of the fission products on the nitrogen chemical potential in (U, Pu)N are estimated. In the carbide fuel the reactions between hypostoichiometric (C/U < 1) and hyperstoichiometric (C/U > 1) fuel and various fission products (Zr, Mo, Ru, Rh, Pd, Y, La, Ce, Pr, Nd, Sm, and Sr) were investigated. The simulated burn up was 10, 20, and 30%. In hypostoichiometric fuel, the following phases were identified: (U, Zr, Mo, S.E.)C, $UMoC_2$, $U_2(Ru,Rh)C_2$, $(U,S.E.)_{x1}(Ru,Rh)_{y1}$ and $(U,S.E.)_{x2}(Ru,Rh,Pd)_{y2}$ where S.E. = rare earths. In hyperstoichiometric fuel the phases identified were: (U, Zr, Mo, S.E.)C, $UMoC_2$, $U_2(Ru,Rh)C_2$, $(U,Zr)Pd_3$, $S.E.C_{1.5-2.0}$ and U_2C_3. The likely fission product reactions in mixed carbide fuel (U, Pu)C at high burn up are deduced on a basis similar to that in the nitride fuel. The consequences of the reaction behavior of the fission products on the carbon chemical potential in (U, Pu)C are estimated. (auth)

21522 (KFK-EXT-6/74-2) STRUCTURE, PREPARATION, AND PROPERTIES OF REFRACTORY COMPOUNDS AND SYSTEMS. Holleck, H.; Thuemmler, F. (Kernforschungszentrum Karlsruhe (F. R. Germany)). Apr 1974. 70p. (In German). Dep. NTIS (US Sales Only) $6.50.

Reports concerning investigations on TaC bearing refractory compounds and systems (63 papers) are summarized. Other papers deal with the preparation and properties of MoC_{1-x} and WC_{1-x} bearing carbide mixed phases, and with x-ray measurements on reactions of Hf-carbonitrides involving the carbide-phase and the binder metal. Thermodynamic and analytical aspects are also discussed. (auth)

21523 (LA–5622-MS) RELATIONSHIP OF FABRICATION PARAMETERS TO SELECTED PROPERTIES OF $^{238}PuO_2$ RADIOISOTOPIC FUELS. I. Dimensional Changes, Stoichiometries, and Microstructural Features. Keenan, T. K.; Kent, R. A.; Zocher, R. W. (Los Alamos Scientific Lab., N. Mex. (USA)). May 1974. Contract W-7405-eng-36. 19p. Dep. NTIS $4.00.

A study to examine the relationship of fabrication parameters to selected properties of $^{238}PuO_2$ has been initiated. The $^{238}PuO_2$ will be used in power sources for RTG's (Radioisotopic Thermal Generators) in space missions; therefore the response of the material to a wide variety of thermal and mechanical stresses must be understood. However, this response is partly a function of the processing of the $^{238}PuO_2$ into the specified geometry of the fuel module. The initial phase of this study concentrated on the microstructural appearance of the fuel following its fabrication under varying conditions. The parameters examined included variations in (1) feed granule size ranges, (2) cold pressing pressures, (3) pre-press seasoning temperatures, (4) hot pressing pressures, and (5) post-press sintering temperatures. The structural differences were correlated with these processing parameters. (auth)

21524 (SGAE-2260) SOFTWARE FOR COATED PARTICLES ANALYSIS. Jakubczyk, G. M.; Krotz, W. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Abt. Mathematik). Apr 1974. 31p. (In German). Dep. NTIS (US Sales Only) $4.75.

21525 (UJV-2933-M) STATIC DISPLACEMENT IN THE NbC CRYSTAL LATTICE AS A CRITERION OF ITS SINTERABILITY. Krivy, I.; Becvar, J. (Ustav Jaderneho Vyzkumu, Rez (Czechoslovakia)). May 1974. 22p. (In Czech).

The determination of vibration characteristics of a crystal lattice by x-ray diffraction at a single temperature was confirmed to be suitable for determining the size of static displacement. A substantial part of static displacement in the original NbC powder could be removed by heating in vacuo for two hours at ≥1100°C. The dependence of static displacement on an annealing temperature of between 20 and 1500°C showed a marked decrease over the narrow range between 800 and 1100°C with the inflection point at 1000°C. Above 1100°C, a measurable crystal growth was observed together with a slightly decreased agglomerate size resulting from material recovery and from NbC lattice recrystallization. The lower limit of the total mean quadratic dynamic displacement of 5.9×10^{-3} A^2 corresponded to a Debye temperature of 690°K, which exceeded the tabulated value by approx. 7%. The dependence of the density of NbC pellets sintered at 2200°C on the temperature of pre-annealing was found to be similar to the temperature dependence of static displacement, thus yielding a suitable criterion for determining the reactivity and consequently the sinterability of the solid phase. (Nucl. Sci. Abstr. Czech.)

21526 (Y-1946) DETERMINATION OF LATTICE PARAMETERS BY A SEARCH-SCAN COMPUTER-ASSISTED DATA ANALYSIS METHOD. Baucum, W. E.; Carpenter, D. A.; Bearden, L. E. Jr.; Sells, K. A. (Oak Ridge Y-12 Plant, Tenn. (USA)). Jul 1974. Contract W-7405-eng-26. 18p. Dep. NTIS $4.00.

A method was developed for determining lattice parameters, using a search-scan technique with computer-assisted data analysis. This method consists of collecting x-ray diffraction data using a search-scan technique which provides useful data

in a digital output format and uses a PDP-15 computer to smooth the data, separate the $K\alpha_1$ from the $K\alpha_2$ x-ray peaks, and find peak locations by fitting a parabola to the top 20% of the separated $K\alpha_1$ peak. Lattice parameters are then calculated by a least-squares refinement procedure. This method has reduced operator time and increased analysis precision. Data are given for titanium and niobium carbides. (auth)

21527 MOLYBDENUM–ZIRCONIA: NEW METALCERAMIC MATERIAL FOR NEW APPLICATIONS. Heitzinger, F. (Metallwerk Plansee, Reutte, Austria). pp 371-390 of Modern Developments in Powder Metallurgy. Vol. 7. Hausner, H. H. (ed.). Princeton, NJ; Metal Powder Industries Federation (1974).

From 4th international conference on powder metallurgy; Toronto, Canada (15 Jul 1973). See CONF-730718-P8.

A brief review of the properties of the most important refractory oxides and metals is given to show the versatility of the molybdenum–zirconia combinations. Properties such as mechanical strength, transition temperature, transverse rupture strength, electrical conductivity, rate of dissolution in molten iron, as well as the thermal shock resistance as a function of composition and structure are discussed. The currently most important practical applications for thermocouple sheaths for temperature measurement in metallic melts, particularly steel, for extrusion dies for the nonferrous metal industry and wear resistant parts are reviewed. (auth)

21528 DISPERSION-STRENGTHENED NICKEL–YTTRIA SHEET ALLOY PRODUCED FROM COMMINUTED POWDERS. Sikora, P. F.; Quatinetz, M. (Lewis Research Center, Cleveland). pp 419-469 of Modern Developments in Powder Metallurgy. Vol. 7. Hausner, H. H. (ed.). Princeton, NJ; Metal Powder Industries Federation (1974).

From 4th international conference on powder metallurgy; Toronto, Canada (15 Jul 1973). See CONF-730718-P8.

Initial efforts to dispersion strengthen nickel with Y_2O_3 in an attempt to replace radioactive ThO_2 as the strengthening phase in dispersion strengthened alloys are reported. Nickel–Y_2O_3 powders were processed by the NASA comminution and blending (NASCAB) method and subsequently thermomechanically worked. Experimental variables included volume percent Y_2O_3 (2% and 4%), powder cleaning temperature (315, 371, and 426°C), a screening step in the process, and the number (up to 23) of cold-roll-anneal cycles. Tensile strength data determined at 1093°C, as well as stress-rupture life data are presented. It is shown that nickel with 4 vol % Y_2O_3 with good 1093°C mechanical properties could be produced by the NASCAB process. The 4% Y_2O_3 composition was stronger than that containing 2% Y_2O_3. The 315 and 371°C cleaning temperatures were equally effective in promoting strength while the 426°C cleaning temperature resulted in lower strength. Powders which were screened during processing generally yielded higher strengths than those not screened. Although the screening was beneficial, it tended to increase the scatter in the data. There is some indication that maximum strength can be obtained at both an intermediate number (10) of cold-roll-anneal cycles and also at a larger number (21) of cycles. A strength level of 124.1 18,000 psi at 1093°C was readily obtained. This compares favorably with Ni–4% ThO_2 made by the same process and with commercial TD–Ni sheet. The stress-rupture results at 1093°C are comparable with the data reported for commercial TD–Ni sheet at 1093°C. (auth)

21529 BEHAVIOR OF TITANIUM DIBORIDE TOWARDS NICKEL–ALUMINIUM. Broussaud, D.; Pastor, H.; Meyer, R.; Accary, A. (Univ. of Clermont, Grenoble, France). pp 589-603 of Modern Developments in Powder Metallurgy. Vol. 7. Hausner, H. H. (ed.). Princeton, NJ; Metal Powder Industries Federation (1974).

From 4th international conference on powder metallurgy; Toronto, Canada (15 Jul 1973). See CONF-730718-P8.

The hot pressing of mixtures of TiB_2 and NiAl leads to samples with a density of practically 100% of theoretical although cold pressing and sintering has been unsuccessful to achieve those densities. Owing to the very high hardness of the TiB_2, it is very difficult to avoid a contamination during milling of the mixture of powders. If the pollution is due to WC, TiC and β-WB appear in the cermet. The oxidation behavior of those cermets is good at 1000°C but very poor at 1200°C. The weakness of this material seems to be associated with the formation in the oxidation layer of 9 Al_2O_3, 2 B_2O_3. (auth)

21530 EFFECT OF CARBON CONTENT ON MECHANICAL PROPERTIES OF TiC–8Mo_2C–15Ni CERMET. Nishigaki, K.; Ohnishi, T.; Shiokawa, T.; Doi, H. (Mitsubishi Metal Corp., Japan). pp 627-643 of Modern Developments in Powder Metallurgy. Vol. 7. Hausner, H. H. (ed.). Princeton, NJ; Metal Powder Industries Federation (1974).

From 4th international conference on powder metallurgy; Toronto, Canada (15 Jul 1973). See CONF-730718-P8.

The effects of carbon content on the growth of the carbide particle-size and the mechanical properties such as hardness, transverse rupture strength, and compressive strength were studied. Particular attention was focused on the respective contribution of carbon content and the carbide particle-size to the mechanical properties. In addition, wear resistance in continuous cutting test of TiC–8Mo_2C–15Ni cermet with wide variation in carbon content was measured and correlated with the mechanical properties. It was found that as the carbon content in the cermet decreases, the (TiMo)C phase around coarse TiC particles grows, and consequently the hardness, transverse rupture strength, and compressive strength decrease. The lowering of the carbon content in general strengthens the binder phase owing to the increased dissolution of Mo and Ti in the binder phase. This results in increase of yield stress in compressive tests and high temperature hardness. The cermet with the carbon content corresponding approximately to the middle position in the two phase ranges which shows high transverse rupture strength and high fracture strain in compressive tests also shows excellent cutting tool performances. (auth)

21531 INFLUENCE OF ABRASIVE POLISHING ON THE STRESS STATE AND TOUGHNESS PROPERTIES OF CEMENTED CARBIDES. Snell, P-O.; Parnama, E. (Fagersta SECO AB, Sweden). pp 645-664 of Modern Developments in Powder Metallurgy. Vol. 7. Hausner, H. H. (ed.). Princeton, NJ; Metal Powder Industries Federation (1974).

From 4th international conference on powder metallurgy; Toronto, Canada (15 Jul 1973). See CONF-730718-P8.

The toughness of WC-base carbides was studied. Results of the investigation show that compressive stresses are introduced in the carbide as well as the binder phase by grinding. Removal of the disturbed surface layer by polishing decreases the compressive stresses in the carbide phase to 25 kg/mm^2 and in the binder phase to 15 kg/mm^2. The polished surface can thus not be considered as undisturbed or as a zero stress state as far as the binder phase is concerned. It has also been shown that there exists an initiation load for crack formation, i.e., the crack length–load curves do not extrapolate through the origin, not even for samples polished down to a depth where the undeformed surface layer should have been reached. For practical determinations of relative toughness values the existence of an initiation load has no great importance as the initiation load is only of the magnitude 1 to 20 kg. Therefore the crack resistance parameter W proposed by Exner may be used as a relative toughness parameter with a good approximation. However, the parameter seems mainly to be a measure of the resistance to crack propagation. In considering the fracture mechanics for different hard metal alloys the crack initiation load should therefore not be neglected. As a new promising technique for the determination of the crack initiation and crack propagation load the acoustic emission method is suggested. One possible advantage with the method is that it might be made independent of the surface preparation. It has also been shown that the transverse rupture strength (TRS) values after grinding are higher than after grinding + polishing. This observation is consistent with the findings that the compressive stresses in the surface layer are decreased by polishing. An influence of an embrittlement of the binder phase by work-hardening after polishing cannot however be completely excluded. (auth)

21532 STRESS-RELAXATION BEHAVIOR OF A POLYCRYSTALLINE ZIRCONIUM–OXYGEN ALLOY BETWEEN 0.3 AND 0.4 T_m. James, W. B.; Davies, T. J. Metal Sci. J.; 8: No. 3, 84-90(Mar 1974).

Stress relaxation tests have been performed on a polycrystalline zirconium–8.5 at. % oxygen alloy at temperatures between 573 and 773°K (0.3 and 0.4 T_m). At a given strain, the strain-rate sensitivity parameter increases monotonically with temperature, indicating that a single thermally activated process is rate controlling. The activation volume characteristic of the deformation process, in which the stress was found to decrease logarithmically with respect to time, was determined. Activation volumes were found to lie in the range 19 to 30 b^3 (where b is the Burgers vector for prismatic slip in zirconium). A lack of success in obtaining values of the dislocation velocity stress exponent β^* has been attributed to the inherent difficulty of applying the particular method of analysis chosen to a material that has a value of $\beta^* > 10$. The overcoming of interstitial oxygen atoms has been tentatively suggested as the thermally activated rate-controlling process during stress relaxation. (auth)

21533 ELECTRICAL PROPERTIES OF PROTON-BOMBARDED $Ga_{1-x}Al_xAs$. Favennec, P. N. (Centre Nacional des Telecommunications, Lannion, France); Diguet, D. Appl. Phys. Lett.; 23: No. 10, 546-547(15 Nov 1973).

The feasibility of forming insulating walls in $Ga_{1-x}Al_xAs$ by proton bombardment was shown and their stability up to a temperature of 180°C was demonstrated. The mean projected range of protons in $Ga_{1-x}Al_xAs$ is determined for energies ranging from 200 to 1200 keV. The insulating properties of proton-bombarded layers are applied to the realization of cross-bar integrated arrays of electroluminescent diodes. (auth)

21534 FRACTURE BEHAVIOR OF ZIRCONIUM–ZIRCONIA COMPOSITES. Virkar, A. V. Evanston, IL; Northwestern University (1973). 152p. University Microfilms Order No. 74-7842.

Thesis (Ph. D.).

Zirconium–zirconia composites with varying volume percent of the metal phase (~10% to ~40%) were hot-pressed to better than 99% of theoretical density in graphite dies in an atmosphere or argon. The microstructure consisted of a continuous network of the metal phase surrounding the oxide grains together with dispersed metal particles. The oxide grain size was ~20 μm. Because of the volume change during the tetragonal ⟷ monoclinic phase transformation in the oxide phase, residual stresses are developed in both the metal and the oxide phases. This was confirmed by performing high temperature dilatometry. The as hot-pressed specimens showed a lower transition temperature than the specimens which were stress-relieved at 850°C (below the transition temperature) for 90 hours. The shift in the transition temperature is associated with the compressive residual stresses in the oxide phase. Fracture surface energy measurements were made using the double cantilever beam technique. The as hot-pressed specimens with ~23 vol % of the metal phase showed a fracture surface energy of ~55 J/m^2 while the stress-relieved specimens with ~23 vol % of the metal phase showed a fracture surface energy of only ~38 J/m^2. A set of specimens with ~23 vol % of the metal phase was stress-relieved at 850°C for 90 hours, heated for ½ hour at 1350°C and rapidly cooled to room temperature. These specimens possessed a fracture surface energy of ~65 J/m^2. The higher fracture surface energy of these specimens and the as hot-pressed specimens compared to the stress-relieved specimens is attributed to the existence of the residual stresses. Two models were developed to explain the phenomenon. Fracture surface energy measurements were made on the specimens with varying amounts of the metal phase. The results are explained on the basis of the residual stresses. The metal phase had a fracture surface energy of ~12 J/m^2 while the extrapolated value of the fracture surface energy for the oxide phase is ~45 J/m^2. Work of fracture measurements were made on the as hot-pressed specimens with ~17 vol % of the metal phase to determine the fracture surface energy for crack propagation. This was found to be equal to the fracture surface energy measured by the double cantilever beam technique. The fracture stress was measured in three point bending. The specimens with ~23 vol % of the metal phase possessed the highest fracture stress, among the specimens tested, with a value of ~276 M Newtons/m^2. Various thermal treatments were given to the specimens. Thermal treatment below the eutectoid, cubic ZrO_2 ⇀ tetragonal ZrO_2 + Zr, resulted in the exudation of the solid metal phase. Thermal treatment above the eutectoid resulted in secondary recrystallization, with the resulting oxide grains up to 5 to 6 mm in size. (Diss. Abstr. Int., B)

21535 LOW TEMPERATURE HEAT CAPACITY OF RUBIDIUM TUNGSTEN BRONZE. Kienzle, W. E. Ames, IA; Iowa State Univ. (1973). 123p. University Microfilms Order No. 74-9127.

Thesis (Ph. D.).

The heat capacity of Rb_xWO_3 ($0.27 \leq x \leq 0.33$) prepared by two techniques, electrolysis and solid state reaction, has been measured from 1 to 14°K and from 1 to 11°K respectively. The single sample grown by solid state reaction exhibited a superconducting transition temperature (T_c) in zero magnetic field of 2.7°K. An applied magnetic field of 5 kG suppressed T_c below 1°K. For temperatures below 4°K the heat capacity in the normal state can be expressed as $C = (2.38\ mJ/mole\text{-}K^2)T + (0.28\ mJ/mole\text{-}K^4)T^3$. An excess heat capacity, present above 4°K, can be explained in terms of a single Einstein mode associated with the vibration of the rubidium ion in the hexagonal channels. From the Einstein temperature of 59°K it was possible to calculate a force constant of $8.5(10^3)$ dyne/cm for this mode. The electrolytically grown samples (EGS) were Type I superconductors with a T_c of 1.8°K which was independent of x-value for $0.27 \leq x \leq 0.33$. An applied magnetic field of 100 gauss was sufficient to suppress T_c below 1°K. The heat capacity of the EGS increased with increasing x-value and showed the presence of an Einstein mode above 4°K. (Diss. Abstr. Int., B)

21536 ELECTRONIC STRUCTURE OF ReO_3. Pearsall, T. P. Ithaca, NY; Cornell University (1973). 143p. University Microfilms Order No. 74-10,893.

Thesis (Ph. D.).

Electronic transport, specific heat, and magnetic susceptibility measurements have been made on single crystals of ReO_3. The results show that ReO_3 has relatively wide conduction bands. The free electron model was found to give a good approximation to experimental results in most cases. A notable failure, however, was seen in the temperature dependence of the Hall effect. The behavior of the dc resistivity with temperature indicates that the principle contributions to the resistivity come from impurity scattering electron-electron scattering, and electron-phonon scattering. The resistivity has a temperature dependence which can be written: $\rho(t) = 0.168\ \mu\Omega\text{-cm} + 13.1\text{-}(T/\theta_R)^2\ \mu\Omega\text{-cm} + 34.5(T/\theta_R)^5 \times J_5(\theta_R/T)\ \mu\Omega\text{-cm}$, θ_R, the Debye temperature is 500°K as determined by resistivity measurements. The Hall effect in ReO_3 was measured between 4.2 and 300°K. The Hall constant at 300°K is -3.28×10^{-4} cm^3/C which is within a few percent of the value calculated by the simplest free-electron model. The temperature dependence of the Hall effect shows, on the other hand, that a relaxation-time approximation for scattering cannot be made. Specific heat and magnetic susceptibility measurements were made to determine the density of states and the strength of correlation effects. The density of states of ReO_3 (0.468 states of one spin/eV-atom) is lower than the corresponding value for free electrons, (0.613 states of one spin/eV-atom). This result is at variance with the usual description of transition-metal compounds as having high densities of states resulting from narrow energy bands. (Diss. Abstr. Int., B)

21537 DETERMINATION OF ELECTRICAL RESISTIVITY OF CEMENTED TUNGSTEN CARBIDES. Philadelphia; American Society for Testing and Materials (1968). 4p. (ASTM-B-421-67).

Two methods are provided. One has high accuracy for determination of the property within 0.30%. The other has a lower accuracy suitable for quality control of the usual shapes and sizes of sintered cemented tungsten carbides. (DLC)

21538 EVALUATING APPARENT GRAIN SIZE AND DISTRIBUTION OF CEMENTED TUNGSTEN CARBIDES. Philadelphia; American Society for Testing and Materials (1969). 6p. (ASTM-B-390-64).

This recommended procedure for the visual comparison and classification of grain size and distribution is limited to cemented tungsten carbides that contain 6, 10, and 18% Co. (DLC)

21539 ELECTRIC PROPERTIES OF γ-IRRADIATED p-TYPE CADMIUM TELLURIDE. Arons, A. A.; Matlak, V. V.; Nikonyuk, E. S.; Ust'yanov, V. I. Radiats. Fiz. Nemetal. Krist.; 3: No. 2, 54-68(1971). (In Russian).

The changes in electric conductivity and distribution and mobility of carriers in p-type CdTe after ^{60}Co γ-irradiation at 300°K were investigated. The crystals, grown by the Bridgman method from spectrally pure initial components, had $5 \times 10^{12} - 10^{14}$ cm^{-3} carrier concentration and 32 to 9 cm^2/V-s hole mobility. The radiation defects of acceptor type, which changed the scattering mechanism, were generated during irradiation. The increase in hole concentration during isochronal annealing at ≤400°K is effected probably by appearance of thermal acceptors caused by transformation of radiation defects. The rate of radiation effect introduction is 1.61×10^{-5} for 1 quantum and the energies of low-temperature and high-temperature defect formation are 0.99 and 1.51 eV, respectively. (Ref. Zh.).

21540 REVISED PHASE DIAGRAM OF THE SYSTEM ZrO_2–$YO_{1.5}$. Srivastava, K. K.; Petil, R. N.; Choudhary, C. B.; Gokhale, K. V. G. K.; Subbarao, E. C. (Indian Inst. of Tech., Kanpur). Trans. J. Brit. Ceram. Soc.; 73: No. 3, 85-91(May 1974).

The subsolidus phase relationships of the ZrO_2-rich portion of the system ZrO_2–$YO_{1.5}$ have been studied by A differential thermal analysis and high temperature x-ray diffractometry. Compositions in the entire system, prepared at 2000°C, have been examined by x-ray diffraction at room temperature. These results, the reported existence of the tetragonal-cubic transformation in ZrO_2, and the liquidus temperatures in the system are incorporated in a revised phase diagram for the system ZrO_2–$YO_{1.5}$. (auth)

21541 THERMAL ELECTRON EMISSION FROM X RAY-IRRADIATED BeO. Kortov, V. S.; Gaprindashvili, A. I.; Pilipenko, G. I.; Lakhov, V. M. (Ural Polytechnical Inst., Sverdlovsk, USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 2, 154-155(1974). (In Russian).

The BeO samples were prepared by sintering BeO powder in vacuum at 1800°C. Measurements of thermostimulated electron emission (TSEE) were carried out in vacuum with the use of a secondary electron multiplier. Heating was linear at a rate of 18 deg/min. Unexcited BeO samples show a single TSEE peak at T = 548–568°K with an emission current density of 800 pulses/sec-cm^2. After x ray irradiation at a dose of 10 to 10,000 rads a sharp rise in the intensity of TSEE peaks is noted at 323 to 450°K

with a supplementary peak at 685°K. The peak height or pulse emission intensity depends on the absorbed dose. (SJR)

21542 TRANSMISSION SPECTRA OF THE SOLID SOLUTION $Cd_{0.2}Hg_{0.8}$ Te OF n- AND p-TYPE OF CONDUCTIVITY. Voitsekhovskii, A. V.; Redko, V. P. (Siberian Physical-Technical Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 8, 152-153(1973). (In Russian).

The fundamental absorption edge of semiconductors of the type $CdxHg_{1-x}Te$ is determined by the forbidden zone width and by the position of the Fermi level for the case of electron degeneracy in the conductivity zone. An absorption edge shift towards greater wavelengths has been noted on lowering the temperature. However in the case of electron degeneracy the absence of such a shift might be expected, if the charge carrier concentration varies slightly or remains unchanged on lowering the temperature. Transmission spectra are presented of $Cd_{0.2}Hg_{0.8}Te$ samples in the energy interval from 0.09 to 0.30 eV on two n-type samples at temperatures of 77 and 300°K, and also on a p-type sample at various temperatures. The p-type sample shows an absorption edge shift towards the side of lesser energies. It was found that the Fermi level for one of the n-type samples increases by 0.06 eV on lowering the temperature from 300 to 77°K, while the width of the forbidden zone decreases by 0.07 eV. Consequently the sum of the Fermi level and of the forbidden zone width remains practically constant over this interval of temperatures for n-type samples of $Cd_{0.2}Hg_{0.8}Te$. This result corresponds with the experimental data. (SJR)

21543 CRYSTAL STRUCTURE OF $W_2FeSi \approx W_6(W_{0.07}Fe_{0.465}Si_{0.465})_7$. Krip'yakevich, P. I.; Yarmolyuk, Ya. P. (Lvov State Univ.). Dopov. Akad. Nauk Ukr. RSR, Ser. A; No. 5, 460-463 (1974). (In Russian).

The crystal structure of W_2FeSi was determined by single crystal x-ray analysis. The structure belongs to a new type: space group is $Pbam-D^1_{2h}$, a = 9.283 ± 0.003, b = 7.817 ± 0.002, c = 4.755 ± 0.001 Å, N = 26; the atom distribution corresponds to the formula $W_6(W_{0.07}Fe_{0.465}Si_{0.465})_7$. As in the cases of W_6Fe_7 and $Nb_6(Ni_{0.75}Al_{0.25})_7$ the structure represents a combination of Zr_4Al_3 and $MgZn_2$ types; three R_6X_7 structures, called homeotypic, differ in the arrangement of Zr_4Al_3- and $MgZn_2$-type fragments combined in the same ratio ($R_6X_7 \approx R_4X_3 \cdot R_2X_4$); R atoms have coordination numbers 16, 15, 14 and X has c. n. 12). (auth)

21544 INVESTIGATION OF THE ENTHALPY AND SPECIFIC HEAT OF MATERIALS BASED ON ZIRCONIUM CARBIDE. Sheindlin, A. E.; Belevich, I. S.; Kozhevnikov, I. G. (Inst. of High Temperatures, Moscow). High Temp. (USSR) (Engl. Transl.); 11: No. 3, 599-601(1973).

Translated from Teplofiz. Vys. Temp.; 11: No. 3, 666-668(1973).

The calorimetric properties of zirconium carbide materials were measured using a mixture method. One group of specimens were near stoichiometric composition while other specimens were deficient in combined C. Results are presented tabularly and compared with those of other workers. (JRD)

21545 A CONSISTENT DESCRIPTION OF ISOTOPIC FISSION GAS RELEASE FOR UZrH-FUEL BELOW 500°C. Fleck, C. M.; Erber, H.; Fritsch, W. (Atominstitut der Oesterreichischen Hochschulen, Vienna). Atomkernenergie; 23: No. 2, 105-108(1974).

3 figs.; 18 refs.

Parameters for the temperature-independent release of fission gas were defined and measured for UZrH fuel, which are totally independent of neutron flux, microscopic surface conditions, and half-life of the released nucleus. Using these parameters, the fission gas release below 500°C of any UZrH fuel can be calculated for any operating mode and power level of the reactor. (GE)

21546 AN IRRADIATION EXPERIMENT ON HTR FUEL SPECIMENS IN THE FGR-2 FOR DETERMINATION OF FISSION GAS RELEASE IN THE TEMPERATURE RANGE BETWEEN 250 AND 1,200 DEGREES CENTIGRADE. Ahlf, J.; Anders, D.; Glauer, J.; Knoth, J.; Marten, R.; Schwenke, H. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Geesthacht-Tesperhude (F. R. Germany). Inst. fuer Werkstofftechnologie; Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Geesthacht-Tesperhude (F. R. Germany). Inst. fuer Physik). Atomkernenergie; 23: No. 2, 109-114 (1974). (In German).

20 figs.; 1 tab.; 3 refs.

A device for irradiation experiments on HTR fuel specimens was built in order to record continually the release of gaseous fission products under well-defined conditions. The analysis of fission gases is carried out on-line by a Ge-Li gamma spectrometer controlled by a processing computer. The temperature dependence in the range between 250 and 1,200°C of the krypton isotopes ^{83m}Kr, ^{87}Kr, ^{88}Kr, ^{89}Kr, ^{90}Kr and the xenon isotopes ^{133}Xe, ^{135}Xe, ^{135m}Xe, ^{137}Xe, ^{138}Xe, and ^{139}Xe from intact coated particles is presented. (GE)

21547 CONFERENCE ON IN SITU COMPOSITES. Volume III. Papers on Physical Properties and Overview of Conference. Conference held in Lakeville, Connecticut, September 5-8, 1972. Washington, DC; National Academy of Sciences (1973). 153p. (NMAB-308-3; CONF-7209117-P3).

Separate abstracts were prepared for five of the ten papers included. (MHR)

For abstracts of individual papers see: 21548, 21549, 21783, 22508, and 22509.

21548 PHYSICAL PROPERTIES OF COMPOSITE MATERIALS. Albers, W. (Philips Research Labs., Eindhoven, Netherlands). pp 1-18 of Conference on in situ Composites. Vol. III. Washington, DC; National Academy of Sciences (1973).

From conference on in situ composites; Lakeville, Connecticut, USA (5 Sep 1972). See NMAB-308-3; CONF-7209117-P3.

Composite properties are discussed from two different points of view: (1) the consequences of structure and morphology, (2) the combination of the different properties of the constituent phases. UO_2-W is one of the examples used. (79 references) (DLC)

21549 OBSERVATIONS ON OXIDE-METAL EUTECTIC SYSTEMS. Hart, P. E. (Battelle Pacific Northwest Labs., Richland, WA). pp 119-127 of Conference on in situ Composites. Vol. III. Washington, DC; National Academy of Sciences (1973).

From conference on in situ composites; Lakeville, Connecticut, USA (5 Sep 1972). See NMAB-308-3; CONF-7209117-P3.

Aligned eutectic structures were observed in the following oxide-metal systems: UO_2-W, ZrO_2-W, MgO-W, Cr_2O_3-Re, Cr_2O_3-Mo, Cr_2O_3-W, $(Al,Cr)_2O_3$-Mo, and $(Al,Cr)_2O_3$-W systems. In these systems, the oxide forms the continuous matrix phase while the metal is typically present in rod form. Cr_2O_3-Mo specimens, large enough for physical property measurements, were grown by directional solidification. Induction heating was used to heat rods of sintered feed stock which had been encapsulated in sealed Mo capsules. Charpy impact strengths of 4.9×10^6 ergs/cm^2 have been measured at room temperature on unnotched, large grained Cr_2O_3-Mo specimens; this value is approximately 2.5 times that of fine-grained Al_2O_3. The measured work of fracture of 40.1×10^4 ergs/cm^2 for the composite structure is approximately 20 times that reported for Al_2O_3. Scanning electron micrographs indicate that the fibers have necked during loading. Criteria necessary for establishing eutectic structures in oxide-metal systems are presently not understood. Pure Al_2O_3 does not appear to form simple eutectics with refractory metals. However, the addition of 5 to 20 wt % Cr_2O_3 to Al_2O_3 yields simple eutectic structures. (auth)

21550 CHANGES IN PHOTOELECTRIC PROPERTIES OF CADMIUM SELENIDE DURING IRRADIATION. Ust'yanov, V. I.; Tarabrova, L. I. Radiats. Fiz. Nemetal. Krist.; 3: No. 2, 78-91 (1971). (In Russian).

The thermally stimulated conductance (TSC), spectral distribution of photoconductance (SDPC), and lux-ampere characteristics (LAC) were studied in CdSe irradiated by ^{60}Co γ-rays (10^5 g-equivalent Ra activity) at low and room temperatures and doses, $\phi = 10^5$ to 10^7 R. The TSC was measured at 0.2°/s; the SDPC was studied at 100 and 290°K; and LAC was recorded in an apparatus with a maximum (white) light flux of 2.28×10^{13} cm^{-2} at 110 and 290°K. Indium was used as contacts for the crystals having 8 to 20 mm^3 volume. The activation energies ϵ, of 3 local traps (0.12, 0.22, and 0.33 eV), detected in initial CdSe, increased with increasing ϕ (by 1.3 times for $\phi = 1.45 \times 10^7$ R) during irradiation of CdSe. The lifetime of charge carriers in irradiated CdSe increased many times at low light fluxes and decreased somewhat at $\geq 10^{14}$ cm^{-2} (at 100 cm^2/V-s$^-$ mobility). The changes in ϵ do not depend on the nature of the traps and are attributed to the decrease (under the effect of γ-radiation) of permittivity in the CdSe lattice caused by the formation of radiation defects. (Ref. Zh.)

21551 RADIATION DEFECTS IN CADMIUM TELLURIDE AFTER LOW-TEMPERATURE γ IRRADIATION. Arons, A. A.; Didkovskii, A. P.; Ust'yanov, V. I. (Radiats. Fiz. Nemetal. Krist.; 3: No. 2, 66-78(1971). (In Russian).

The effect of γ-radiation on the electric properties of p-type CdTe, having 10^{-5} and Ω^{-1}-cm^{-1} conductance and irradiated at 77 and 170°K, respectively, was investigated. The electric conductance and Hall emf were measured at 77 to 300°K. The radiation dose was 10^6 R for high-resistance samples and 10^7 R for low-resistance. The defects generated by γ-radiation in the p-type CdTe decrease hole concentration and change the mechanism of hole scattering in high-resistance crystals. In low-resistance crystals, no changes in mechanisms of hole scattering were observed in the temperature range studied. The energy of hole activation in irradiated high-resistance material is 0.39 eV (0.34 eV in the nonirradiated state) and 0.012 eV in low-resistance

material (0.016 eV in the nonirradiated state). An increase in the mobility of charge carriers was observed in high-resistance material after irradiation in the entire temperature range: In low-resistance CdTe, the mobility decreased somewhat after irradiation. These changes in structural state of high-resistance crystals were more rapid than in low-resistance crystals. The rate of radiation defect production at 180 to 200°K was 6.67×10^{-4} per incident quantum. (Ref. Zh.)

21552 TRANSIENT AND REVERSIBLE DIFFUSIONAL CREEP. A Study on Uranium Dioxide. Burton, B.; Reynolds, G. L. (Central Electricity Generating Board, Berkeley, Eng.). Phil. Mag.; 29: No. 6, 1359-1370(Jun 1974).

The existence of dislocation links in crystals provides internal sources and sinks for vacancies. Under an applied stress, diffusion between these sources and sinks can lead to diffusional strain. At low stresses this diffusional strain will saturate out as dislocations climb to their equilibrium radius of curvature, thus providing a transient diffusional creep component in addition to the steady-state component arising from diffusion between grain boundary sources and sinks. On stress removal this transient strain should be reversible since bowed dislocations will return to their new equilibrium configuration. The magnitude and rates of these effects are calculated and comparisons are made with results obtained on uranium dioxide. (auth)

21553 ESR STUDY ON THE STRUCTURAL DEFECTS IN IRRADIATED ZIRCONS. Solntsev, V. P.; Shcherbakova, M. Ya. (Inst of Geology and Geophysics, Novosibirsk, USSR). Dokl. Phys. Chem.; 212: No. 1-3, 731-733(Sep 1973).

Translated from Dokl. Akad. Nauk SSSR; 212: No. 1, 156-158 (Sep 1973).

Transparent and slightly yellowish single zircon crystals from deposits in the Ural were examined by means of ESR spectra before and after irradiation by ^{60}Co γ rays at 77°K. Defects associated with impurities were identified. Results show that γ irradiation results in simultaneous formation of two center types: electron centers involving electron capture by a Zr^{4+} cation (Zr^{3+} α, β, and γ centers), and hole centers involving electron loss by one of the oxygen atoms (centers 4, 5, 6). Relations were established between the Zr^{3+} α center and Me^{+} (Li, Na, K), between the centers Zr^{3+} β, 6, 7, and oxygen vacancies, between center 4 and Al in Si^{4+} positions and pairwise substitution of $Zr^{4+}-Zr^{4+}$ by $Y^{3+}-Y^{3+}$. (DLC)

21554 FORMS OF "SURFACE" OXYGEN ON VANADIUM PENTOXIDE. Bakumento, T. T.; Roiter, V. A. (Inst. of Physical Chemistry, Kiev). Dokl. Phys. Chem.; 212: No. 1-3, 743-745(Sep 1973).

Translated from Dokl. Akad. Nauk SSSR; 212: No. 2, 392-394 (Sep 1973).

The energy of O_2 chemisorbed on purified V_2O_5 was studied in relation to the temperature dependence of the equilibrium pressure of the O_2. The effects of a standard treatment (degassing at 500°C, O_2 treatment at 10 torr, cooling to 50°C, evacuation to 10^{-5} torr) and of evacuation at 500°C were determined The Clausius-Clapeyron equation is used to calculate the ratio of chemisorbed O_2 to the maximum saturation O_2. The chemisorption heat q_s is determined to be 41 kcal/mole O_2 after the standard treatment and 76 kcal/mole O_2 after 500°C evacuation. The latter value is due to O_2 removal from the V_2O_5 surface layer without the formation of the lower-oxide phase. Entropy changes indicate that in the 500°C evacuation, O_2 removal results in increased disorder of the oxide crystal. (DLC)

21555 CONTRIBUTION TO THE SYSTEM NIOBIUM-TANTALUM-NITROGEN. Brauer, G.; Mohr-Rosenbum, E. (Univ., Freiburg i. B.). Z. Anorg. Allg. Chem.; 405: No. 3, 225-229 (May 1974). (In German).

Niobium-tantalum alloys react at 1400°C with NH_3 or N_2 of normal pressure to form mixed nitrides with a composition close to the formula $(Nb, Ta)N_{0.9}$. The nitrides more rich in niobium have the cubic δ-NbN type structure (NaCl type); the nitrides more rich in tantalum have the hexagonal ϑ-TaN type structure (WC type). (auth)

21556 MORPHOLOGIES OF REFRACTORY CARBIDES OBTAINED BY DIRECTIONAL SOLIDIFICATION IN THE EUTECTIC SYSTEMS Ni-TaC, Co-TaC, AND Fe-TaC. Walter, J. L.; Cline, H. E. (General Electric Co., Schenectady, NY). pp 61-74 of Conference on in situ Composites; Vol. I. Washington, DC; National Academy of Sciences (1973).

From conference on in situ composites; Lakeville, Connecticut, USA (5 Sep 1972). See NMAB-308-1; CONF-7209117-P1.

An investigation was conducted to determine the mechanisms by which orientation and morphology changes occur in these systems. Directionally solidified ingots of the eutectics Co-TaC, Ni-TaC, and Fe-TaC and alloys of these containing Cr have been prepared. The amount of TaC added was greater than the eutectic composition to produce both primary crystals of TaC and fibers of TaC in the same ingot. It was by examination of the faceted TaC primary crystals that an understanding of the factors determining fiber orientation and morphology was gained. The primary TaC crystals in the TaC systems with only Co, Ni, or Fe for the matrix were all cubic or rectangular in shape with {100} facet faces, the slow growth faces. It is likely that the rapid growth direction of particles with these facet planes is parallel to ⟨111⟩. The TaC fibers in all three systems were mixtures of trifoils, blades, and whiskers with ⟨111⟩ parallel to the fiber axis. With the addition of Cr, the primary crystals in the Ni-TaC system formed as octahedra with {111} faces; the direction of rapid growth of the crystals was ⟨100⟩. The fiber orientation was also ⟨100⟩ and the fibers were generally square in cross section. In the cobalt alloy with Cr, the crystals were pseudo-octahedral with each triangular face consisting of three facets. The fibers were mainly rods and blades with some trifoils all with ⟨100⟩ directions parallel to the fiber axis. The crystals in the iron alloy with TaC were cubo-octahedra; both {100} and {111} facets were present. Thus, the rapid growth direction of the particles is ⟨110⟩. The fibers consisted of blades and plates with ⟨110⟩ axes. In the NiCr-TaC alloy, fibers of one orientation grew coincidental with a matrix of a different orientation. The fiber shape was determined by the difference in orientation. The presence of alloying elements affects the morphology of the crystals by changing the habit plane or the plane of slow growth of the crystal. Similarly, the habit plane at the tip of the growing fiber is also changed by the alloying element affecting both the orientation and shape of the fibers. It is concluded that these eutectics form as aggregations of independent crystals growing simultaneously but not contiguously. (auth)

21557 SEEDING AND GROWTH OF LARGE CERAMIC EUTECTIC INGOTS. Schmid, F.; Viechnicki, D. (Army Materials and Mechanics Research Center, Watertown, MA). pp 119-127 of Conference on in situ Composites. Vol. I. Washington, DC; National Academy of Sciences (1973).

From conference on in situ composites; Lakeville, Connecticut, USA (5 Sep 1972). See NMAB-308-1; CONF-7209117-P1.

The gradient furnace technique has been used to grow large ceramic eutectic ingots, i.e., 5 cm diameter and 3 cm high, in the system $Al_2O_3-Y_3Al_5O_{12}$. In the past unseeded eutectic melts have resulted in ingots with large columnar grains, i.e., 2 to 3 mm by 20 to 30 mm, which have limited bend strengths of the material to 5000 psi. A study of seeding ceramic eutectic melts using the gradient furnace technique was undertaken. The columnar grains were eliminated by seeding with "a" oriented or "c" oriented sapphire. $Al_2O_3-Y_3Al_5O_{12}$ eutectic seeds and $Y_3Al_5O_{12}$ seeds proved unsatisfactory. (auth)

21558 PREPARATION AND PROPERTIES OF DIRECTIONALLY SOLIDIFIED $ZrO_2-Y_2O_3$ EUTECTIC. Hulse, C. O.; Batt, J. A. (United Aircraft Research Labs., East Hartford, CT). pp 129-140 of Conference on in situ Composites. Vol. I. Washington, DC; National Academy of Sciences (1973).

From conference on in situ composites; Lakeville, Connecticut, USA (5 Sep 1972). See NMAB-308-1; CONF-7209117-P1.

Directionally solidified ingots of the $ZrO_2-Y_2O_3$ eutectic were prepared by the floating molten zone technique using the radiant heat from a thin carbon rf ring susceptor in an argon atmosphere. The eutectic microstructure is lamellar and occurs at 10.2 wt % ZrO_2. Room temperature bend strengths were independent of solidification speed at rates from 1.5 to 40 cm/h (interlamellar spacings from 8.5 to 2.4μ). This independence may reflect the presence of critical flaws resulting from poor eutectic microstructures and/or stresses created during ingot fabrication or sample preparation. The critical flaw size was estimated to be the order of the smallest spacing produced. The bend strength was essentially independent of temperature up to 1500°C. Fracture surfaces, particularly those created at room temperatures, contained extensive areas of uniform steps indicating that the propagation of cracks was affected by the presence of the eutectic microstructure. (auth)

21559 PREPARATION OF IN SITU COMPOSITES BY EDGE-DEFINED, FILM-FED GROWTH (EFG) DIRECTIONAL SOLIDIFICATION. Cocks, F. H.; Pollock, J. T. A.; Bailey, J. S. (Tyco Lab., Inc., Waltham, MA). pp 141-156 of Conference on in situ Composites. Vol. I. Washington, DC; National Academy of Sciences (1973).

From conference on in situ composites; Lakeville, Connecticut, USA (5 Sep 1972). See NMAB-308-1; CONF-7209117-P1.

The application of a new method of crystal growth to the directional solidification of eutectic materials is described. This method is called edge-defined, film-fed growth (EFG) because

the shape of the resultant solid is controlled by the outside dimensions of a die, and liquid feeding occurs because of the pressure difference which exists across a thin meniscus film fed by capillary action. EFG has previously been applied to the growth of a large number of shaped single crystal materials and appears to offer important advantages in the directional solidification of eutectic materials as well. Experimental results which have been obtained with Al_2O_3/UO_2, Al_2O_3/ZrO_2, $Al_2O_3/MgO \cdot Al_2O_3$, CaF_2/LiF, and $Cu/ZrCu_3$ eutectics are described. Directionally solidified Al_2O_3/ZrO_2 (Y_2O_3 stabilized) eutectic filaments 10 mil in diameter and more than 50 feet in length have been produced which show strengths greater 65,000 psi at 1620°C. (auth)

21560 UNIDIRECTIONAL SOLIDIFICATION OF TUNGSTEN IN STABILIZED ZIRCONIA AND HAFNIA. Watson, M. D.; Johnson, T. A.; Benzel, J. F.; Chapman, A. T. (Georgia Inst. of Tech., Atlanta). pp 157-168 of Conference on in situ Composites. Vol. I. Washington, DC; National Academy of Sciences (1973).

From conference on in situ composites; Lakeville, Connecticut, USA (5 Sep 1972). See NMAB-308-1; CONF-7209117-P1.

Cermet composites of $ZrO_2-Y_2O_3-W$ and $HfO_2-Y_2O_3-W$ containing millions of less than one micron diameter tungsten fibers per square centimeter were prepared by a floating zone technique utilizing direct radiofrequency heating. The effects of compositional variables, growth atmospheres, rf field frequencies, and growth rates on composites grown from these systems were determined. Oxide areas which contained tungsten platelets precipitated in the solid state were also observed. Structural defects which produced discontinuous fibers were identified and some of their causes determined. (auth)

21561 UNIDIRECTIONAL SOLIDIFICATION OF A VANADIUM CARBIDE-GRAPHITE EUTECTIC. Lewis, M. H.; O'Sullivan, J. M. (Univ. of Warwick, Coventry, Eng.). pp 169-179 of Conference on in situ Composites. Vol. I. Washington, DC; National Academy of Sciences (1973).

From conference on in situ composites; Lakeville, Connecticut, USA (5 Sep 1972). See NMAB-308-1; CONF-7209117-P1.

A composite material of graphite and the cubic vanadium carbide ($VC_{0.87}$) has been prepared by unidirectional solidification of the eutectic at 2625°C using vertical zone melting in a pressurized helium atmosphere. The resulting microstructures were examined by optical microscopy and both transmission and scanning electron microscopy. Particular use was made of ion-beam thinning techniques in the preparation of thin sections for in-situ examination of both eutectic phases. The eutectic microstructure consists of thin interconnected graphite plates in the carbide matrix, similar to broken-lamellar morphologies in other eutectics. The graphite lamellae, which are nearly parallel to the growth axis, have (0001) interface planes but no particular preference for growth direction within this plane. The matrix phase is the non-stoichiometric cubic carbide in which the random arrangement of carbon atoms, occupying interstices in the fcc vanadium atom structure, becomes ordered on post-solidification cooling. Surfaces of specimens fractured in transverse bending show extensive crack branching and "pull-out" of the graphite phase, characteristic of a composite with a weakly bonded interface, resulting in a high work of fracture compared with that of the matrix phase. (auth)

21562 MECHANICAL BEHAVIOR OF UNIDIRECTIONALLY SOLIDIFIED COMPOSITES. Bibring, H. (Office National d'Etudes et de Recherches Aerospatiales, Chatillon, France). pp 1-69 of Conference on in situ Composites. Vol. II. Washington, DC; National Academy of Sciences (1973).

From conference on in situ composites; Lakeville, Connecticut, USA (5 Sep 1972). See NMAB-308-2; CONF-7209117-P2.

The fabrication technique of in situ grown composites is described. Using this technique, the multiple operations of sorting, alignment, infiltration or sintering, required by the fabrication of conventional synthetic composites are achieved in a single metallurgical operation. The effects of this fabrication technique on crystal structure, properties of solid phase interfaces, volume fraction and properties of solid phases, and crystallographic orientation in composite materials are described. (JRD)

21563 TENSILE AND FRACTURE BEHAVIOR OF A Ni(Cr)-TaC FIBROUS EUTECTIC. Henry, M. F. (General Electric Research and Development Center, Schenectady, NY). pp 173-186 of Conference on in situ Composites. Vol. II. Washington, DC; National Academy of Sciences (1973).

From conference on in situ composites; Lakeville, Connecticut, USA (5 Sep 1972). See NMAB-308-2; CONF-7209117-P2.

A pseudo-binary eutectic of a nichrome matrix and TaC fibers was chosen as a model for alloys with a ductile matrix and a strong, stiff, aligned second phase. Tensile tests were performed from room temperature to 1000°C. Tests were conducted at strain rates from 0.002 to 0.2 in./in./min, with impact tests added as an upper bound on strain rate. Special emphasis was placed on mechanisms causing failure of the aligned fibers. Crack density in the reinforcing fibers was determined as a function of strain in the composite. Fractography was performed to study final composite failure modes. (auth)

21564 STRUCTURE AND MECHANICAL BEHAVIOR OF DIRECTIONALLY SOLIDIFIED Co-NbC EUTECTIC ALLOY. Patarini, V. M.; Kattamis, T. Z. (Univ. of Connecticut, Storrs). pp 187-200 of Conference on in situ Composites. Vol. II. Washington, DC; National Academy of Sciences (1973).

From conference on in situ composites; Lakeville, Connecticut, USA (5 Sep 1972). See NMAB-308-2; CONF-7209117-P2.

The pseudobinary Co-7.8% NbC eutectic alloy was directionally solidified at constant gradient and various growth rates. For low growth rates the carbide assumed a "trilamellar" morphology consisting of lamellae grouped three at a time in a star-like fashion of 120° angle. With increasing growth rate the carbide lamellae transformed into rods and finally back into lamellae and ribbons. The effects of microstructure on room and elevated temperature tensile behavior and on elevated temperature creep and fatigue properties were investigated. In general the material with rod-like carbide morphology exhibited better properties. (auth)

21565 EFFECT OF THERMAL CYCLING ON HIGH TEMPERATURE EUTECTIC COMPOSITES. Breinan, E. M.; Thompson, E. R.; Lemkey, F. D. (United Aircraft Research Labs., East Hartford, CT). pp 201-222 of Conference on in situ Composites. Vol. II. Washington, DC; National Academy of Sciences (1973).

From conference on in situ composites; Lakeville, Connecticut, USA (5 Sep 1972). See NMAB-308-2; CONF-7209117-P2.

The effect of temperature cycling on a variety of directionally solidified high temperature eutectic composites has been investigated. Alloys studied included: Ni-NbC, Ni,Cr-NbC, Co,Cr-NbC, Co,Cr,Ni-TaC, Ni_3Al-Ni_3Nb, and (Ni,Cr), $(Ni_3Al)-Ni_3Nb$. Self-resistance heating was used to impose approximately two minute temperature excursions over ranges of 750 to 2050°F, 550 to 1850°F, and 300 to 1600°F. It was found that all the monocarbide-reinforced systems investigated were severely damaged by repeated cycling between 750 and 2050°F, as a result of internally generated stresses. The susceptibility of these alloys to damage was found to depend upon the maximum temperature encountered in the thermal cycle. The Ni_3Al-Ni_3Nb alloy and the (Ni,Cr), $(Ni_3Al)-Ni_3Nb$ alloy were far more resistant to thermal fatigue damage than the monocarbide-reinforced alloys. The susceptibility of the systems to damage was generally correlatable with the differences between the thermal expansion coefficients of the eutectic phases. From these observations it was concluded that the specific thermal fatigue characteristics which are unique to aligned, two-phase materials must be a criterion to be evaluated in the development of high temperature eutectic composites. (auth)

21566 STUDY OF CRYSTALLOGRAPHIC AND DIELECTRIC PROPERTIES AND NONLINEAR OPTICS OF SOME NEW PHASES OF COMPOSITION $Ba_x Li_{5-2x} Nb_{5(1-y)} Ta_{5y} O_{15}$ AND THE TETRAGONAL STRUCTURE OF TUNGSTEN BRONZES. Ravez, J. (Univ., Bordeaux); Perron, A.; Chaminade, J. P.; Hagenmuller, P.; Rivoallan, L. J. Solid State Chem.; 10: No. 3, 274-281 (Jul 1974). (In French).

Two series of phases with tetragonal bronze-like structure and composition $Ba_xLi_{5-2x}T_5O_{15}$ (T = Nb, Ta) were isolated in the systems $BaNb_2O_6-LiNbO_3$ and $BaTa_2O_6-LiTaO_3$. All these phases show ferroelectric-paraelectric transitions. The Curie temperature increases with the lithium content. The value of T_c for $Ba_{2.08}Li_{0.84}$ is the highest ever observed for this type of structure: the obtained phases are potentially good materials for the harmonic generation of the 0.53-μm radiation. The optical yield of the niobate $Ba_{2.14}Li_{0.71}Nb_5O_{15}$ is about 2.5 times that of $Ba_2NaNb_5O_{15}$ and 250 times that of the K. D. P. The crystallographic and dielectric data of the system $Ba_{2.14}Li_{0.71}Nb_5O_{15}-Ba_{2.14}Li_{0.71}Ta_5O_{15}$ characterize three domains, which are respectively antiferroelectric, ferroelectric, and paraelectric. The Curie temperature and the optical yield decrease with increasing tantalum content. (8 fig, 21 references) (auth)

21567 PREPARATION AND CHARACTERIZATION OF $CdVO_3$ PREPARED AT AMBIENT AND HIGH PRESSURE. Chamberland, B. L.; Danielson, P. S. (Univ. of Connecticut, Storrs). J. Solid State Chem.; 10: No. 3, 249-251 (Jul 1974).

The solid state reaction of VO_2 and CdO yielded a phase of unknown structure, which transforms to $CdVO_3$(I) after treatment under 60-65 kbar pressure at 1200°C. The high-pressure product was characterized by crystallographic, electrical, and magnetic properties. $CdVO_3$(I) is an orthorhombic perovskite-type compound and a metallic conductor, exhibiting Pauli paramagnetic behavior. In contrast, the ambient pressure phase displays Curie-Weiss magnetic behavior above 77°K.

21568 ANNUAL REVIEW OF MATERIALS SCIENCE. Volume 4. Huggins, R. A. (ed.). Palo Alto, CA; Annual Reviews, Inc. (1974). 467p. $12.00.

Fifteen papers in this volume deal with nondestructive testing methods, NMR, defect structures, ion implantation, optical properties, semiconductors, tribology, light scattering, electrical properties, magnetic systems, strong ceramics, fire-retardant polymers, and biomedical materials in surgery. Separate abstracts were prepared for the two papers on defect structures and ion implantation. Author and subject indexes are included, as well as the cumulative indexes for Vols. 1–4. (DLC)

For abstracts of individual papers see: 21569 and 21861.

21569 SOME DEFECT STRUCTURES IN CRYSTALLINE SOLIDS. Hyde, B. G. (Univ. of Western Australia, Nedlands); Bagshaw, A. N.; Andersson, S.; O'Keeffe, M. O. Annu. Rev. Mater. Sci.; 4: 43-92(1974).

A review is presented of extended defects and the structural organization of crystals. Ideas about extended defects are expanded from inorganic chemistry to alloys and minerals, and from the crystallographic shear concept to other structure-building principles. Besides crystallographic shear in ReO_3, rutile, and other structure types, rotation, twinning, intergrowth, vernier, and crowdion structures are also discussed. It is shown how the more highly organized structures are developed from simpler ones by simple operations (shear, rotation, etc.). (44 fig, 97 references) (DLC)

21570 NEW ORDERED PEROVSKITES. Brixner, L. H. (E. I. du Pont de Nemours and Co., Wilmington, DE). Mater. Res. Bull.; 9: No. 8, 1041-1044(Aug 1974).

Compounds of the type $ALaBB'O_6$ (where A = Sr, Ba, B = Li, Na, K, B' = Mo, W) have been prepared. All are ordered perovskites crystallizing in space group Fm3m. $BaLaLiWO_6$ melts congruently and single crystals could be grown by the Czochralski technique. The molybdenum analog $BaLaLiMoO_6$ could only be obtained at 65 kbars pressure. (auth)

21571 SUPERCONDUCTIVITY AND STRUCTURAL BEHAVIOR OF HEXAGONAL MoN AND RELATED Mo COMPOUNDS. Vandenberg, J. M.; Matthias, B. T. (Bell Telephone Labs., Inc., Murray Hill, NJ). Mater. Res. Bull.; 9: No. 8, 1085-1090(Aug 1974).

The results of high-pressure synthesis of hexagonal MoN are reported. Its transition temperature T_c is in the range 14.8 to 13°K. The high T_c superconductivity is related to the presence of a superlattice, caused by clustering of Mo. The occurrence of Mo clustering in other superconducting or nonsuperconducting Mo compounds is discussed. (auth)

21572 CRYSTAL STRUCTURES OF THE HIGH AND LOW TEMPERATURE FORMS OF RHOMBOHEDRAL Cr-DOPED V_2O_3. Robinson, W. R. (Purdue Univ., West Lafayette, IN). Mater Res. Bull.; 9: No. 8, 1091-1096(Aug 1974).

X-ray diffraction studies of single crystals of $(Cr_{0.01}V_{0.99})_2O_3$ have shown that the transition from the low to high temperature rhombohedral forms of this material proceeds without changing the orientation of the unit cell axes. The structures of both the high and low temperature forms have been determined at 23°C using single crystal x-ray diffraction techniques. Both forms are isomorphous with V_2O_3, but upon heating the M-M distance across the shared octahedral face increases from 2.700(1) Å to 2.747(1) Å while the M-M distance across the shared edge increases from 2.884(1) Å to 2.917(1) Å. The M-O distances increase by a maximum of 0.011Å. The low temperature form of $(Cr_{0.01}V_{0.99})_2O_3$ is isostructural with V_2O_3 while the high temperature form is isostructural with $(Cr_{0.031}V_{0.969})_2O_3$. (auth)

21573 STATISTICAL MECHANICAL MODELS FOR INTERSTITIAL SOLID SOLUTIONS OF HYDROGEN IN Nb, V, AND Ta. Stafford, S. W.; McLellan, R. B. (Rice Univ., Houston, TX). Acta Met.; 22: No. 9, 1147-1153(Sep 1974).

The variation of the partial thermodynamic functions of hydrogen solute atoms with solute concentration in the Group V metals Ta, V, and Nb were analyzed using models in which both repulsive and attractive solute mutual interactions are considered. The comparison between the experimental data and the calculated thermodynamic functions is in favor of the repulsive interaction model in which relatively short range interactions restrict the solute atoms to cells of interstitial sites. It has been shown that, at low temperature, the population of cells by more than one solute atom occurs only to a small extent. The experimental evidence in favor of H–H interactions of the attractive and repulsive kind is discussed. (26 references) (auth)

21574 PHASE RELATIONS IN THE SYSTEM Bi_2O_3–WO_3. Hoda, S. N.; Chang, L. L. Y. (Miami Univ., Oxford, OH). Amer. Ceram. Soc.; 57: No. 7, 323-326(Jul 1974).

From 75th annual meeting of the American Ceramic Society; Cincinnati, OH (1 May 1973).

Phase relations in the system Bi_2O_3–WO_3 were studied from 500 to 1100°C. Four intermediate phases, $7Bi_2O_3 \cdot WO_3$, $7Bi_2O_3 \cdot 2WO_3$, $Bi_2O_3 \cdot WO_3$, and $Bi_2O_3 \cdot 2WO_3$, were found. The $7Bi_2O_3 \cdot WO_3$ phase is tetragonal with $a_0 = 5.52$ Å and $c_0 = 17.39$ Å and transforms to the fcc structure at 784°C; $7Bi_2O_3 \cdot 2WO_3$ has the fcc structure and forms an extensive range of solid solutions in the system. Both $Bi_2O_3 \cdot WO_3$ and $Bi_2O_3 \cdot 2WO_3$ are orthorhombic with (in Å) $a_0 = 5.45$, $b_0 = 5.46$, $c_0 = 16.42$ and $a_0 = 5.42$, $b_0 = 5.41$, $c_0 = 23.7$, respectively. Two eutectic points and one peritectic exist in the system at, respectively, 905 ± 3°C and 64 mol% WO_3, 907 ± 3°C and 70 mol% WO_3, and 965 ± 5°C and 10 mol% WO_3. (auth)

21575 OXIDATIVE NONSTOICHIOMETRY IN PEROVSKITES, AN EXPERIMENTAL SURVEY: THE DEFECT STRUCTURE OF AN OXIDIZED LANTHANUM MANGANITE BY POWDER NEUTRON DIFFRACTION. Tofield, B. C.; Scott, W. R. (Oxford Univ.). J. Solid State Chem.; 10: No. 3, 183-194(Jul 1974).

Oxide perovskites showing oxidative nonstoichiometry (ABO_{3+x}) were investigated. The structure of $LaMn^{3+}_{.76}Mn^{4+}_{.24}O_{3.12}$ was investigated by powder neutron diffraction and a composition $(La_{0.94 \pm 0.02}\square_{0.06 \pm 0.02})(Mn^{3+}_{0.745}\ Mn^{4+}_{0.235}\square_{0.02})O_3$ with partial elimination of La_2O_3 and vacancies on both the A and B metal sites determined. A much smaller degree of nonstoichiometry has been found for $LaVO_{3+x}$ ($x \leq 0.05$), and $LaCrO_3$, $LaFeO_3$, and $EuTiO_3$ did not show nonstoichiometry under the conditions used. A single-phase region from $Ba_{0.8}La_{0.2}Ti^{4+}_{0.8}Ti^{3+}_{0.2}O_{3.0}$ to $Ba_{0.8}La_{0.2}Ti^{4+}O_{3.1}$ has been confirmed for lanthanum-doped $BaTiO_3$, but the solubility of La^{3+} in $SrTiO_3$ is very small; consideration of the ionic radii indicates that the dopant ion of higher oxidation state must be significantly smaller than the normal ion to stabilize a wide nonstoichiometric region with B site vacancies. The extensive nonstoichiometry shown by $LaMnO_{3+x}$, in contrast to the other lanthanum-transition-metal perovskites $LaBO_3$, may result from the much larger reduction in ionic radius from Mn^{3+} to Mn^{4+} than is found for other transition-metal ions. (4 tables) (auth)

21576 THERMODYNAMIC STUDY OF THE SYSTEM NbO_2–Nb_2O_5 AT HIGH TEMPERATURE. Marucco, J. F. (Paris Univ., Orsay, France). J. Solid State Chem.; 10: No. 3, 211-218(Jul 1974).

The partial pressure of oxygen in equilibrium with niobium oxides was determined from thermogravimetric gas-equilibrium measurements over the range 1000–1100°C. Hysteresis phenomena were shown, and a method was perfected to eliminate these phenomena. Two nonstoichiometric stable phases, $NbO_{2.42}$ and $NbO_{2.47}$, were found. A new partial phase diagram is proposed. (9 fig) (auth)

21577 SOLUBILITIES OF COPPER AND MANGANESE IN β-RHOMBOHEDRAL BORON AS DETERMINED IN $CuB_{\sim 28}$ AND $MnB_{\sim 23}$ BY SINGLE-CRYSTAL DIFFRACTOMETRY. Andersson, S.; Callmer, B. (Univ. of Uppsala). J. Solid State Chem.; 10: No. 3, 219-231(Jul 1974).

The structures of two crystals with the compositions $CuB_{\sim 28}$ and $MnB_{\sim 23}$ were determined using single-crystal diffractometry. The compositions probably represent the maximum solubility of copper and manganese in β-rhombohedral boron. The space group is $R\bar{3}m$, and the hexagonal axes are $\alpha = 10.970$ Å and $c = 23.890$ Å for $CuB_{\sim 28}$, and $\alpha = 10.988$ Å and $c = 23.994$ Å for $MnB_{\sim 23}$. The three-dimensional boron network of β-rhombohedral boron is retained almost unchanged in the two compounds and the metal atoms are situated in holes in this network. In $MnB_{\sim 23}$ the manganese atoms partly occupy three crystallographic positions. In $CuB_{\sim 28}$ one of these positions is split up into two and the copper atoms consequently occupy four crystallographic positions. (8 tables) (auth)

21578 NATURE OF ANGULAR CARBIDES IN HIGH-SPEED STEEL. Taran, Yu. N.; Nizhnikovskaya, P. F.; Pogrebnoi, E. N. Metal Sci. Heat Treat. (USSR) (Engl. Transl.); 16: No. 1-2, 104-107(1974).

Translated from Metalloved. Term. Obrab. Metal; 16: No. 2, 10-13(Feb 1974).

The crystal structure and composition of angular carbides in Fe–C–W alloys were investigated. It was found that high-temperature annealing of Fe–C–W alloys with 1.69 to 1.81% C and 19.7 to 11.2% W leads to the division, spheroidization, and coalescence of the eutectic cubic carbide $(W, Fe)_6C$ and the nucleation and growth of angular hexagonal WC, at the expense of reducing the amount of cubic carbide. Some of the individual carbide particles in the structure of high-speed steels after treatment at high temperatures result from the transformation of carbide in the course of which the metastable binary carbide $(W, Fe)_6C$ is transformed into stable WC. (auth)

21579 PROPERTIES OF SEVERAL FORMS OF HYDROUS MOLYBDENUM TRIOXIDE. Sotani, M.; Saito, Y.; Oita, M.;

Hasegawa, M. (Kobe Univ., Japan). Nippon Kagaku Kaishi; 1974: No. 4, 673-679(Apr 1974). (In Japanese).

Five species of hydrous molybdenum trioxide were prepared under various conditions and investigated by DTA-TGA, X-ray diffractometry, IR and NMR spectrometries to get detailed informations regarding structures and their thermal behaviors. Three of these five hydrous oxides were confirmed to be hydrates of trioxide (yellow dihydrate: sample A, yellow monohydrate: sample B and white monohydrate: sample D). Sample A transformed a sample B at 105°C by liberating one molecule of water. Sample B transformed to MoO_3, having a rhombic crystal structure, (rhombic MoO_3) at 165°C by liberating residual one molecule of water. Sample D also transformed to rhombic MoO_3 through amorphous trioxide and hexagonal MoO_3 by elevation of temperature. The remaining two were confirmed to be trioxide (hydrous rhombic MoO_3; sample C and hydrous hexagonal MoO_3; sample E). Sample C, which had a rhombic crystal structure, was prepared by treating sample A with hot water at about 70°C for several hours. It was gradually dehydrated by heating from room temperature to about 400°C without any structural transformation. Sample E, which had a hexagonal crystal structure, was prepared by the hydrolysis of ammonium paramolybdate in 2 ~ 3 mole acidic solution at about 70°C. It was also dehydrated by heating from room temperature to about 400°C without showing any change in structure. Transformation to rhombic MoO_3 took place at 420 ~ 430°C. This hexagonal MoO_3 was newly found meta-stable oxide. These two oxides were considered to occlude water in interstitial position of crystal lattice. (auth)

21580 CRYSTALLIZATION OF AMORPHOUS UO_2. Matzke, H.; Nitzki, V.; Ronchi, C. (European Inst. for Transuranium Elements, Karlsruhe, Ger.). Thin Solid Films; 22: No. 1, 75-82(May 1974).

Evaporation of bulk UO_2 during electron-beam heating led to the condensation of amorphous UO_2 films. The substrates were amorphous carbon films kept at ambient temperature. The UO_2 films recrystallized at $T_c = 675 \pm 15°C$, as verified by electron diffraction. This crystallization temperature T_c is used in a thermal spike model which predicts structural stability for UO_2 against radiation damage, providing that $T_c/T_m \lesssim 0.3$ (T_m is the melting point in °K). With a measured T_c/T_m of 0.30, the criterion is fulfilled, and this gives an explanation for the known absence of phase changes in UO_2 during reactor irradiation. (35 references) (auth)

21581 PROPERTIES OF BORON FIBERS AND BORON-ALUMINUM COMPOSITES IN UNIAXIAL COMPRESSION. Mileiko, S. T.; Sorokin, N. M.; Tsirlin, A. M. (Inst. of Solid-State Physics, Moscow). Strength Mater. (USSR) (Engl. Transl.); 5: No. 6, 686-690(Jun 1973).

Translated from Probl. Prochnosti; 5: No. 6, 41-45(Jun 1973).

Experimental data obtained from tests on aluminium alloy reinforced with boron fibers are presented. Results of the experiment are compared with computed characteristics of the composite material, on the basis of which the optimal conditions are determined for reinforcing metallic matrix with brittle high-modulus fibers in the case of loading the material by uniaxial compression. The maximum stresses of stability loss in compression of a composite B-Al rod amount to about 300 kg/mm^2. They reach this value of some optimal fiber content near $\frac{1}{3}$. Further increase in reinforcing fibers is unsuitable. It should be noted that limiting stresses of this order are obtained on composites with fibers of any of the three types studied. This confirms the view that structural defects in the fibers, being effective stress concentrators in tension, have practically no effect on the behavior of fibers in compression. It is possible that boron fibers with different strength characteristics may differ somewhat in Young's modulus. But, if a small difference in modulus exists, it is insignificant from the viewpoint of limiting stresses in compression of composite rods. (auth)

21582 YTTRIATED TUNGSTEN ELECTRODES FOR WELDING IN SHIELDING GAS. Loginov, V. P. (Inst. of High Temperatures, Moscow). Weld. Prod. (USSR) (Engl. Transl.); 20: No. 2, 47-48(Feb 1973).

Translated from Svar. Proizv.; 20: 28-29(Feb 1973).

New non-consumable electrodes, which can be supplied to official specifications have been developed; they have much longer life in inert gas welding with straight-polarity direct current. In many cases inadequate life of tungsten electrodes in inert-gas welding leads to transfer of the electrode material into the weld metal, resulting in a reduction of the serviceability of the welded structures or the need to repair welded joints while they are being produced. The rod-type electrodes are yttriated W containing 1.5 to 2.3% Y_2O_3 having diameters of 2, 3, 4, 5, 6, 8 and 10 mm and lengths of 120 to 200 mm. It was found possible to reduce tungsten consumption as compared with consumption of lanthanated tungsten electrodes and in this way reduce the quantity of tungsten inclusions in welds. (JRD)

Metals and Alloys

Refer also to abstract 20807.

21583 MODERN DEVELOPMENTS IN POWDER METALLURGY. Volume 8. Ferrous P/M and Special Materials. Proceedings of the 1973 International Conference Held at Toronto, Canada, July 15-20, 1973. Hausner, H. H.; Smith, W. E. (eds.). Princeton, NJ; Metal Powder Industries Federation (1974). 685p. (CONF-730718-P8). $42.50.

Thirty-two papers presented at conference are included in Volume 8. A separate abstract was prepared for each of nineteen papers selected for inclusion in NSA. (JRD)

For abstracts of individual papers see: 21527-21531, 21620-21622, and 21674-21684.

21584 RARE EARTH METALS AND ALLOYS WITH SPECIAL PHYSICAL PROPERTIES. Terekhova, V. F. pp 89-92 of Splavy Redkikh Metallov s Osobymi Fizicheskimi Svoistvami. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian)

The diverse physical properties of the rare earth metals and alloys makes it possible to find constantly among them new materials for electronic and other areas of technology. The high electrical resistance, small work function, ferromagnetism, high magnetic susceptibility, and a series of other special properties of the rare earth metals offers the possibility of using their alloys as heating elements, cathode materials, special magnets with high energy, and semiconducting materials. During a very wide-ranging study of the physical properties of the rare earth alloys, still more effective new materials were found. (tr-auth)

21585 STUDY OF THE PROPERTIES OF MONOCRYSTALS OF GADOLINIUM-DYSPROSIUM ALLOYS. Levitin, R. Z.; Savitskii, E. M.; Terekhova, V. F.; Chistyakov, O. D.; Yakovenko, V. L. pp 100-107 of Splavy Redkikh Metallov s Osobymi Fizicheskimi Svoistvami. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

A method for the growth of monocrystals of Gd alloys with Dy is described. A study was made of the anisotropy of the magnetization intensity and the microhardness. The anisotropy constant K_1^1 was calculated from the experimental data. The experimental studies indicated that the uniaxial magnetic anisotropy of Dy and its alloys with Gd has a one-ion nature. (tr-auth)

21586 LESS COMMON METALS AND ALLOYS AS A MEANS OF IMPROVING ELECTROVACUUM INSTRUMENTS. Iofis, N. A. pp 181-184 of Splavy Redkikh Metallov s Osobymi Fizicheskimi Svoistvami. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian)

New alloys with increased frequency were developed. They were Ni with W, a binary alloy of Ni with Re in the solid solution region, steels with additions of Hf and Zr, and a ternary Fe-Ni-Re alloy. Si-alkaline metal additions to pure W and alloys of W with Re were developed for heaters. An alloy of Ti with Zr and Al and of Zr with Al was introduced in the production of gas absorbers. Active alloys with a La-Sc and La-Al base were developed. To increase the reliability and lifetime of electrovacuum instruments a high quality of materials is necessary. Less common metals and their alloys have a prominent place in the production of these instruments. (tr-auth)

21587 CONFERENCE ON IN SITU COMPOSITES. Volume I. Keynote Address, Introductory Remarks, and Papers on Solidification and Resulting Structure. Conference held in Lakeville, Connecticut, September 5-8, 1972. Washington, DC; National Academy of Sciences (1973). 318p. (NMAB-308-1; CONF-7209117-P1).

Twenty-one papers presented at the conference are included in Volume I. A separate abstract was prepared for each of nine papers selected by NSA scope. Papers for which no abstracts were prepared are concerned with eutectics and eutectoids containing out-of-scope metals and alloys. (JRD)

For abstracts of individual papers see: 21556-21561, 21645, 21774, and 21775.

21588 CONFERENCE ON IN SITU COMPOSITES. Volume II. Papers on Mechanical Properties. Conference Held in Lakeville, Connecticut, September 5-8, 1972. Washington, DC; National Academy of Sciences (1973). 335p. (NMAB-308-2; CONF-7209117-P2).

From conference on in situ composites; Lakeville, Connecticut, USA (5 Sep 1972).

Twenty papers presented at the conference are included in Volume II. A separate abstract was prepared for each of eleven papers selected by NSA scope. Papers for which no abstracts

were prepared are concerned with eutectics and eutectoids containing out-of-scope alloys and metals. (JRD)

For abstracts of individual papers see: 21562–21565 and 21776–21782.

Corrosion and Erosion

21589 (AERE-R-7734) FORMATION OF CAVITIES IN STEELS EXPOSED TO LIQUID SODIUM. Stoneham, A. M. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). May 1974. 21p. Dep. NTIS (US Sales Only) $4.25. UK 50 pence.

The observations of cavities in steels exposed to liquid sodium are analysed to identify the mechanism of formation of the observed cavities and the relation to the austenite–ferrite transitions seen at the same time. The cavities appear to result from the leaching of Ni, Cr, and other elements from grain boundaries and other fast-diffusion paths. No significant diffusion within the grains, nor surface-limited steps, appear to be involved in cavity formation. The austenite-ferrite transition also involves grain-boundary diffusion, but also requires diffusion within the individual grains. The long-term behavior and the question of possible deleterious effects of the cavities on mechanical properties are discussed. (auth)

21590 (COO-2313-1) LIQUID LITHIUM CORROSION RESEARCH. Progress Report, April 1, 1973–December 31, 1974. Olson, D. L.; Bradley, W. L. (Colorado School of Mines, Golden (USA)). 1974. Contract AT(11-1)-2313. 25p. Dep. NTIS $4.25.

A laboratory was built for research on the alkali metals and their alloys. It includes two controlled-atmosphere boxes equipped with furnaces and temperature controllers. Tensile testing capability is also now available in one box. At 800°C, liquid lithium penetration of grain boundaries of a 304L stainless steel occurred to a depth of 0.271 mm in 14 h. Initial weight gains and subsequent weight losses are attributed to liquid lithium penetration at the grain boundaries followed by dissolution of whole grains into the melt. Preliminary grain-boundary grooving experiments are now in progress. Experiments on the interaction of stresses and liquid lithium corrosion are now underway. Studies of liquid lithium corrosion of the heterogeneous region surrounding a weld in 304 stainless steel is also being initiated. A feasibility study has suggested that it should be possible to build a liquid lithium-forced convection system using a Wilfley pump. An experimental technique is being developed for measuring and controlling the amount of nitrogen impurity in the liquid lithium. (DLC)

21591 (INIS-mf-1293) ZIRCALOY CLADDING TUBE INFORMATION. Aas, S.; Videm, K.; Lunde, L.; Lunde, K.; Granlund, A.; Rose, R. (Raufoss Ammunisjonsfabrikker A/S (Norway)). [nd]. 47p. INIS.

The first reprint is from Nuclear Engineering and Design, 21: 237-253(1972) and was in an earlier form presented in INIS RNO 19 842. The factors affecting mechanical interactions between UO_2 pellet fuel and zircaloy cladding are treated in detail, the effects of fuel-canning gap, pellet shape, and length being presented. Swelling and ratcheting are discussed and the properties of zircaloy considered. The second reprint is from Nuclex 72, Technical Meeting No. 5, and discusses the in-reactor behavior and properties of zircaloy cladding tubes. Inside hydriding and fuel–cladding interactions are discussed, as are strain fatigue corrosion and anodizing. The third reprint is from "Peaceful Uses of Atomic Energy," vol. 8 and deals with the properties and manufacture of zircaloy cladding tubes. Following a presentation of in-pile deformation characteristics of a fuel rod the mechanical properties of zircaloy are discussed. The effects of heat treatments and working on the texture, especially the hydride platelet orientation and surface treatments are also dealt with. The final paper compares anodizing with other surface finishing. (NO)

21592 (ORNL-TM-4621) LOW-PRESSURE OXIDATION OF T-111 AND EFFECT ON TENSILE PROPERTIES. Inouye, H.; Liu, C. T. (Oak Ridge National Lab., Tenn. (USA)). Aug 1974. Contract W-7405-eng-26. 25p. Dep. NTIS $4.25.

The kinetics of the oxygen contamination of T-111 by low-pressure gases was determined, and the resulting degradation of the tensile properties was measured to allow predictions of the useful life and establish the permissible limit of oxygen in the alloy when used as the capsule for containing $^{238}PuO_2$. The contamination rate of T-111 with low-pressure oxygen, water vapor, and the gases outgassed from graphite and Min-K insulation varied directly with the gas pressure, varied inversely with the alloy thickness, was constant with time, and was relatively insensitive to temperature between 825 and 1200°C. The ductility of T-111 decreased sharply with the oxygen content except at 760 and 825°C; at these temperatures an increase in the strain-hardening rate allowed the ductility to remain unchanged from the annealed values up to 500 or 750 ppM O. The tolerance of T-111 for oxygen doubled on increasing the contaminating temperature from 825 to 1000°C and increased by an additional order of magnitude at 1200°C. Service temperature between 760 and 825°C and the use of a diffusion barrier of molybdenum are considered to be the optimum conditions for using T-111 in this application. (auth)

21593 (RFP-2207) ORGANIC COATING OF URANIUM–4.2 WT. % NIOBIUM. Riegel, R. L. (Dow Chemical Co., Denver, Colo. (USA). Rocky Flats Div.). 24 Jun 1974. Contract AT(29-1)-1106. 16p. Dep. NTIS $4.00.

Research has shown that an organic coating protects the U–4.2 wt % Nb alloy from stress corrosion cracking if the coating remains intact. Intentionally damaged coatings provide limited protection. Good adhesion was obtained without elaborate surface preparation. (auth)

21594 EFFECT OF RARE EARTH ELEMENTS ON THE OXIDIZABILITY OF ALLOYS WITH A NICKEL–CHROMIUM BASE. Abramova, N. B.; Ignatov, D. V.; Lazarev, E. M. pp 113-116 of Splavy Redkikh Metallov s Osobymi Fizicheskimi Svoistvami. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian)

The effect of additions of rare earth elements (Y, La, and Ce) on the oxidation kinetics of the alloys Ni–10% Cr, Ni–10% Cr–6% W, and Ni–10% Cr–6% Mo was studied at 1000° in air. The phase composition and structure of the cinder were studied. The introduction of rare earth elements decreases their oxidation rate 3 to 10 times. (tr-auth)

21595 TRENIE I IZNASHIVANIE PRI VYSOKIKH TEMPERATURAKH. (Friction and Wear at High Temperatures). Khrushov, M. M. (ed.). Moscow; Izdatel'stvo Nauka (1973). 155p.

Thirty-three papers are included in the book. An abstract was prepared for one paper selected by NSA scope. (JRD)

For an abstract of an individual paper see: 21700.

21596 METHOD FOR SURFACE TREATMENT OF ARTICLES OF ZIRCONIUM AND ITS ALLOYS. Gregers, V. K.; Henk, K. (to Institutt for Atomenergi). Norwegian Patent 123,007. 21 Dec 1971. Filed Date 24 Dec 1969. vp.

In order to create a protective oxide film, Zr or Zr alloy is oxidized by heating in an oxidizing medium after etching in a fluoride bath, fluoride compound residues being removed from the surface or neutralized by anodic oxidation. Zircaloy-2, Zircaloy-4, Zr–1.0% Cr–0.16% Fe, Zr–2.5% Nb–0.5% Ta, and other alloys were etched in 41-4-55 HNO_3–HF–H_2O for 3 min at 33°, and were then exposed to the air until an insoluble film of oxy- and hydroxyfluorides had formed, and washed with water. Specimens were anodized in acidic, basic or neutral electrolytes (0.5% NH_4OH, 1% KNO_3, 0.5% NaOH, 1% Na_3PO_4, etc.) at 20°, using a Pt plate cathode and with the voltage gradually increased from 0 to 125V at 5 V/sec. After 1 min at the maximum voltage, specimens were washed and dried, and then exposed to superheated stream at 400° to a weight gain of 15 to 29 g/dm^2. (Corrosion Abstr.)

21597 KINETICS OF NITRIDE-FORMING REACTIONS IN LIQUID URANIUM–TIN ALLOYS. Schicks, T. G. Stanford, CA; Stanford University (1973). 172p. University Microfilms Order No. 74-6542.

Thesis (Ph. D.)

The gas-liquid kinetics of nitride-forming reactions in induction-stirred liquid uranium–tin alloys were studied using a constant pressure Sieverts-type apparatus in the 1500 to 1800°C temperature range. The overall reaction was found to be $U + \frac{1}{2} N_2(g) \rightleftharpoons UN(s)$. Since the rate of uranium nitride formation was found to be strongly influenced by melt geometry, stirring, nitrogen pressure, uranium concentration and, to a lesser extent, the melt temperature, it was concluded that the overall process possesses the characteristics of mixed rate control by (a) mass transfer of dissolved nitrogen in the liquid alloy followed by (b) a reversible chemical reaction in the stirred bulk liquid. A combined rate equation, including both the rate of mass transfer of dissolved nitrogen in the liquid alloy and the rate of the reversible chemical reaction, has been derived and has been used to calculate and reproduce the experimental nitriding rate curves for various temperatures, pressures, and uranium concentrations (up to 20% by weight). The physical characteristics of the uranium mononitride (UN) precipitate were examined by autoradiography, metallography, x-ray diffraction, electron microscope, and electron microprobe. A study of the rates of the nitride decomposition reaction was also conducted. (Diss. Abstr. Int., B)

21598 APPLYING STATISTICS TO ANALYSIS OF CORROSION DATA. Philadelphia; American Society for Testing and Materials (1971). 22p. (ASTM-G-16-71).

A set is presented of sample procedures that are in current usage in statistical analysis of corrosion experiments. Errors, standard deviation, probability, curve fitting, sample size, variance analysis, etc. are discussed. Alloys in the examples include Al–5% Mg, Alcan 3S-0, and Zircaloy-2. (DLC)

21599 DEVELOPMENT OF OXIDE DIFFUSION-BARRIER ON REFRACTORY METALS. Roy, C.; Pastein, S. (Univ. of Western Ontario, London). J. Mater. Sci.; 9: No. 6, 1004-1010 (Jun 1974).

A new approach to the development of diffusion-barrier coatings which can effectively reduce the interaction of refractory filaments such as tungsten and tantalum with a nickel-alloy matrix is presented. This consists of reacting the oxide film deliberately grown on these metals with a nickel coating prior to fabricating the composite. The nickel–oxide film reactions proceed under vacuum conditions in the temperature range 650 to 800°C with the formation of intermediate phases which produce sufficiently strong bonds for composite strengthening. The details of the reaction mechanisms are not known but two types of reaction are identified. Type 1 which is a common reaction to both the Ni/oxide/Ta and the Ni/oxide/W systems constitutes a displacement reaction at the Ni/oxide interface leading to the formation of new phases and type 2 is controlled by the bulk diffusion of nickel through the compact oxide film with the development of a diffusion zone at the oxide/substrate interface. Type 2, which is only observed in the Ni/oxide/W system, is believed to confer remarkable chemical stability at 800°C in vacuo. (auth)

21600 EXOELECTRONIC EMISSION OF OXIDIZED ALLOY Zr–1% Nb. Kortov, V. S.; Saenko, G. P.; Polezhaev, Yu. M.; Gaprindashvili, A. I.; Anisimova, I. A. At. Energ. (USSR); 36: No. 5, 370-373(May 1974). (In Russian).

An exoelectron emission method was used for the first time to investigate the corrosion properties of Zr–1% Nb alloy oxidized in various media. Mechanical treatment, cold rolling and oxidation increase emission activity of the alloy. Oxidic films on the alloy become emissively active after electronic bombardment, as a result of which oxy vacancies are filled. This is accompanied by the creation of emission centers, which when vacated cause emission maxima to appear upon subsequent heating. Exoemission maxima identification has been made by comparing emission properties of oxidic film and zirconium dioxide with various degrees of non-stoichiometry. Emission parameters depend both on anion defectivity and on the strained state of alloy oxidic films. The exoemission method is useful in investigating corrosion mechanisms of zirconium alloys and its further development may lay the foundation for evaluation of their corrosion resistance. (tr-auth)

21601 FORMATION OF ZIRCONIUM DIOXIDE IN A MOLYBDENUM ALLOY. Sukhovarov, V. F.; Ul'chenko, V. L.; Kol'chuzhkina, A. I.; Danyushchenkov, I. A. (Tomsk Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 8, 107-112(1973). (In Russian).

Formation of zirconium oxide was observed on annealing a deformed Mo alloy containing 0.11% Zr, 0.002% B, 0.004% C, and 0.002% O_2. Particles of ZrO_2 were seen to form on an electron microscope at places of former subgrains, at grain boundaries and within the grains. A study was made on the size, shape, and distribution of particles at various depths from the sample surface after annealing at various temperatures. The crystallographic orientation of the ZrO_2 particles with respect to Mo matrix was determined. The results of the study indicate that oxygen penetrates the alloy during annealing (dynamic vacuum of 1×10^{-4} to 7×10^{-3} mm Hg std) by enriching the subgrains with oxygen and by developing an internal oxidation reaction. (SJR)

21602 FIELD ELECTRON MICROSCOPE AND SCANNING ELECTRON MICROSCOPE STUDIES OF THE INITIAL OXIDATION STAGES OF MOLYBDENUM. Helwig, R. D. Milwaukee; Univ. of Wisconsin (1973). 181p. University Microfilms Order No. 74-8974.

Thesis (Ph. D.).

Surface migration activation energies for oxide deposits from MoO_2 and MoO_3 sublimation sources on molybdenum were measured with an FEM. The resulting values were 17 ± 3 kcal/mole between 550 and 950°K and 13 ± 3 kcal/mole between 500 and 800°K, respectively. Two other values were observed: an additional value of 23 ± 2 kcal/mole between 500 and 600°K for the oxide deposit from MoO_3; and 21 ± 4 kcal/mole for an oxide layer that moved from the {001} planes for both types of deposit sources and that required a nearby source of deposited oxide. The main oxide boundaries receded rapidly from the {011} vicinals and did not move from the {001} planes. Clusters, likely to have been MoO_3 nuclei, appeared in the vicinity of the boundary upon heating heavy oxide deposits. Clusters were also observed after adsorbing water vapor onto a clean molybdenum FEM tip at room temperature and at a pressure of 1×10^{-4} torr. Upon subsequent heating between 560 and 900°K, they increased in number at random locations, except on the central area of the (011) plane. For both cases, the clusters disappeared at temperatures approaching the melting point of 1063°K for bulk MoO_3. A layer of oxide, presumed to be MoO_2, became visible in the cases of the oxide deposits and was stable up to about 1340°K. Above 1400°K, the desorption sequences for both the water vapor adsorption and the oxide deposits were the same as for saturated oxygen adsorption. A single crystallite of oxide, 200 Å in diameter, was formed during the adsorption of oxygen on a molybdenum FEM tip at a temperature of 1000°K and at partial pressures in the 10^{-5} to 10^{-4} torr ranges. The crystallite appeared as a single bright spot in the FEM and was located between the (112) and (001) planes of the tip. Observation with the FEM was confirmed by TEM observation of the same tip. Larger scale observations with an optical microscope showed MoO_3 crystallite growth on molybdenum in air between 800 and 1000°K; such growth even occurred on the foreign W and Pt metals that were attached to some of the samples. A very mobile oxide layer, which was likely to contain $(MoO_3)_3$, became visible as a liquid-like layer at a temperature of 900°K and was responsible for MoO_3 crystallite growth. Droplets were observed on MoO_3 platelets during their growth. Molybdenum oxide crystallites and their growth on oxidized molybdenum tips were observed with the FEM. FEM image interpretation was aided by comparative SEM studies. Careful analysis of the crystal growths that were typical for the various temperature ranges were made with the SEM. The main species were whiskers and platelets; however, rare forms, such as curled platelets and hollow whiskers, were occasionally observed. Crystallites were observed on areas of samples that were at 700°K during oxidation in air. SEM studies of oxidized molybdenum wires which had been heated in vacuum showed that very small whiskers with diameters less than 200 Å developed at the corners of MoO_3 platelets. It is likely that this type of whisker was due to a plastic flow mechanism and was responsible for the doublet and quadruplet patterns that were observed with the FEM. FEM observations indicated that the applied electric field promoted whisker growth. Such promotion of growth could be due to either mechanical effects of the field forces or to field binding effects. The latter increase the binding energies in areas of high local electric field, such as at the ends of whiskers, for particles that have a high degree of polarizability or a permanent dipole moment. (Diss. Abstr. Int., B)

21603 MECHANICAL-TECHNOLOGICAL AND CHEMICAL CORROSION PROPERTIES OF FERRITIC CHROMIUM–MOLYBDENUM STEELS WITH MORE THAN 17% Cr/PLUS/. Oppenheim, R.; Lannartz, G. (Deutsche Edelstahlwerke GmbH, Krefeld, Ger.). pp 139-141 of Proceedings of the Fifth European Conference on Corrosion. Rueil-Malmaison; Societe de Chimie Industrielle (1973). (In German).

From 5th European conference on corrosion; Paris, France (24 Sep 1973).

A description is presented of a series of tests of a variety of properties of ferritic chromium-molybdenum steels containing 28 per cent chromium and 2 per cent molybdenum and very low carbon and nitrogen contents (less than 0.010 per cent). In testing the mechanical-technological properties of these steels, particular attention was paid to the problem of the notch toughness from room temperature to below 0°C. In studying the chemical-corrosion behavior of these steels, attention was paid to special forms of corrosion, such as intergranular corrosion, pitting corrosion, and stress crack corrosion, and also to corrosion caused by various inorganic and organic acids. (IAA)

21604 HIGH TEMPERATURE GAS-METAL REACTIONS IN MIXED ENVIRONMENTS. Proceedings of the Symposium, Boston, Massachusetts, May 9 10, 1972. Jansson, S. A.; Foroulis, Z. A. (eds.). New York; Metallurgical Society of the American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc. (1973). 415p. (CONF-720515-).

Seventeen papers are arranged into three sections dealing with general aspects of gas–metal reactions; carburization and nitridation reactions; and oxidation in mixtures and complex reactions (sulfation, etc.). Separate abstracts were prepared for seven of the papers. (DLC)

For abstracts of individual papers see: 21605–21610 and 21784.

21605 GENERAL KINETIC CONSIDERATIONS OF REACTIONS AT ELEVATED TEMPERATURES. Hauffe, K. H.; Morrison, S. R. (Univ., Goettingen, Ger.). pp 33-62 of High Temperature Gas–Metal Reactions in Mixed Environments. Jansson, S. A. (Ed.). New York; Metallurgical Society of the American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc. (1973).

From 4th annual spring meeting of the metallurgical society of AIME; Boston, Massachusetts, USA (8 May 1972). See CONF-720515-.

The structure of the growing oxide layer on metals and the point-defect concentration determines the type of rate law and the speed of oxidation. If the growing oxide layer is compact and coherent and, furthermore, the concentration of the point defects of the migrating ion is small, then generally the rate of oxidation is governed by a parabolic rate law. If the oxide layer exhibits a porous structure or a large number of grain boundaries and dislocations, a linear rate law can occur because a phase-boundary reaction may become rate-determining. In a case where the diffusion via ion vacancies or via interstitial positions is the rate-determining step, there is a possibility of increasing or decreasing the diffusion and the rate of oxidation by doping the oxide crystal with foreign ions of lower or higher valence than that of the host lattice ions. This requires a sufficient solubility of the foreign ions in the growing oxide layer without formation of a new phase. Besides the linear and the parabolic rate laws, other rate laws such as the cubic, the fourth power and the logarithmic rate laws have been found, particularly in the thin oxide film region. In general, these rate laws are caused by electric field-transport phenomena, the mechanism of which is rather complex. Due to the appearance of protective oxide layers during the oxidation of alloys, the rate of oxidation can be decreased drastically. Such retardation of the oxidation is similar to the inhibition and passivation processes well known in the aqueous corrosion. (60 references, 10 figures) (auth)

21606 MECHANICAL PROPERTIES OF SCALES AND THEIR INFLUENCE ON HIGH TEMPERATURE GAS–METAL REACTIONS. Cathcart, J. V. (Oak Ridge National Lab., TN). pp 63-83 of High Temperature Gas–Metal Reactions in Mixed Environments. Jansson, S. A. (Ed.). New York; Metallurgical Society of the American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc. (1973).

From 4th annual spring meeting of the metallurgical society of AIME; Boston, Massachusetts, USA (8 May 1972). See CONF-720515-.

It is shown that surface stresses between 10^5 and 10^6 psi are frequently generated during oxidation of metals, and several stress generating mechanisms are discussed. The influence of such stresses on scale rupture, structure, and morphology, on diffusion rates within the scales, and on the shape change experienced by oxidation specimens is pointed out. Evidence for extensive high-temperature plasticity in oxides is cited, and the oxidation behavior of two U-base alloys is described by way of emphasizing the importance of the mechanical properties of scales in gas-metal reactions. (10 figures, 27 references) (auth)

21607 CARBURIZATION OF STAINLESS STEELS IN METHANE–HYDROGEN. Stanley, J. K. (Aerospace Corp., El Segundo, CA). pp 143-154 of High Temperature Gas–Metal Reactions in Mixed Environments. Jansson, S. A. (Ed.). New York; Metallurgical Society of the American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc. (1973).

From 4th annual spring meeting of the metallurgical society of AIME; Boston, Massachusetts, USA (8 May 1972). See CONF-720515-.

Four austenitic stainless steels (AISI Types 304, 316, 321, and 347) were carburized in a methane–hydrogen mixture up to 25 hr in a temperature range of 870 to 1040°C. The carburized case was found to consist of a mixture of chromium carbide (Cr_7C_3) and austenite. The kinetics of the carburization can be described by the relationship: $X^2 = 2Kt$. The carburization constant, K, as a function of temperature follows the familiar Arrhenius relationship: $K = Ae^{-Q/RT}$. The activation energy, Q, for the four stainless grades is 86,000 cal/mol, indicating that the kinetics of the carburized case formation are the same for each steel. All four steels carburize very much alike; only Type 321 was slightly more difficult to carburize (because of TiO_2 film formation) than the other three. (auth)

21608 CARBURIZATION OF REFRACTORY METALS IN HYDROCARBONS. Hoerz, G.; Lindenmaier, K. (Max-Planck-Institut fuer Metallforschung, Stuttgart). pp 168-181 of High Temperature Gas–Metal Reactions in Mixed Environments. Jansson, S. A. (Ed.). New York; Metallurgical Society of the American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc. (1973).

From 4th annual spring meeting of the metallurgical society of AIME; Boston, Massachusetts, USA (8 May 1972). See CONF-720515-.

At high temperatures and low pressures, Nb and Ta react with methane and acetylene to form gaseous hydrogen and metal–carbon solid solutions. It is shown that during carburization the electrical resistivity of Nb and Ta is increased markedly by the absorption of carbon, and that at constant hydrocarbon partial pressure the rate of the reaction of the metals with methane is several orders of magnitude slower than the rate of reaction with acetylene. Simple reaction models are proposed and the kinetics of the reactions are discussed. Finally it is pointed out that the carbon solubility limit in Nb and Ta increases from very small values at low temperatures to values of a few at. % at high temperatures. (auth)

21609 NITRIDING OF REFRACTORY METALS. Fromm, E.; Hoerz, G. (Max-Planck-Institut fuer Metallforschung, Stuttgart). pp 230-247 of High Temperature Gas–Metal Reactions in Mixed Environments. Jansson, S. A. (Ed.). New York; Metallurgical Society of the American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc. (1973).

From 4th annual spring meeting of the metallurgical society of AIME; Boston, Massachusetts, USA (8 May 1972). See CONF-720515-.

Investigations of the thermodynamics of the nitriding of group Va and VIa refractory metals show the existence of equilibria between nitrogen molecules in the gas phase and nitrogen atoms in the α solid solution phase. But there exist marked differences between the nitrogen systems of Nb and Ta and of Mo and W. In the case of Nb and Ta, the solubility ranges lie at much higher nitrogen concentrations and at much lower nitrogen pressures than in the case of Mo and W. Furthermore, the nitrogen absorption reaction is exothermic for the Va metals, but endothermic for the VIa metals. Investigations in the ternary Nb–Mo–N system reveal a continuous change in the heat of solution of nitrogen and in the entropy of solution of nitrogen as the host lattice composition is varied from pure Nb to pure Mo. Also, substantial differences exist between group Va and group VIa metals in the kinetics of nitrogen absorption and desorption and these are correlated with the corresponding thermodynamic properties. (9 figures) (auth)

21610 CRITICAL ROLE OF NITROGEN DURING HIGH TEMPERATURE SCALING OF ZIRCONIUM. Evans, E. B. (Florida State Univ., Tallahassee); Tsangarakis, N.; Probst, H. B.; Garibotti, N. J. pp 248-281 of High Temperature Gas–Metal Reactions in Mixed Environments. Jansson, S. A. (Ed.). New York; Metallurgical Society of the American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc. (1973).

From 4th annual spring meeting of the metallurgical society of AIME; Boston, Massachusetts, USA (8 May 1972). See CONF-720515-.

Iodide Zr was scaled at 600 to 1300°C in air and various oxygen–nitrogen mixtures. Nitrogen was responsible for many unusual scaling features. First, it apparently induced a crystal structure change of normally monoclinic ZrO_2 to the cubic form. Second, it reacted to form ZrN which was usually found at the metal interface underneath an outer oxide layer. Third, it caused scale cracking and a breakaway in the oxidation rate (cubic to linear) when the nitride underwent, in time, a secondary reaction. And fourth, the secondary reaction produced a deformation of the underlying metal such that the lateral surface area was increased as much as 200%. These features require the joint presence of nitrogen with oxygen since the phenomena were not observed in pure oxygen or pure nitrogen. Scaling in consecutive atmospheres (nitrogen to oxygen, nitrogen to air, oxygen to air, and the reverse order) confirmed the critical role of nitrogen in the unusual scaling behavior of Zr. (19 figures, 21 references) (auth)

21611 CORROSION OF NIOBIUM IN OXYGEN CONTAMINATED SODIUM. Thorley, A. W.; Tyzack, C. (United Kingdom Atomic Energy Authority, Warrington, Eng.). pp 259-262 of Proceedings of the Fifth European Conference on Corrosion. Rueil–Malmaison; Societe de Chimie Industrielle (1973).

From 5th European conference on corrosion; Paris, France (24 Sep 1973).

A study of the corrosion behavior of niobium in sodium has been carried out using test loops which are basically electromagnetically pumped, figure-of-eight circuits. Annular niobium specimens were machined from bar material to produce test pieces. Six specimens were arranged consecutively in a specially designed holder and exposed in the hottest part of the test loop. Sodium passes through the bore of the specimen and different velocities are obtained by altering the mass flow from the pump. The results demonstrate that increasing the temperature, oxygen level, and the velocity of the sodium increases the corrosion rate of niobium. The activation energy for the corrosion process has been derived and this is about 33 kcal/g mole. Also, the corrosion rate has been found to have a linear dependence on oxygen concentration in the temperature range 450 to 600°C. (IAA)

21612 CORROSION OF ZIRCONIUM AND OF ITS ALLOYS IN HYDROCHLORIC AND SULFURIC MEDIA. Charquet, D. (Ugine-Aciers, Grenoble, France); Bastien, J.; Dabosi, F. pp 123-128 of Proceedings of the Fifth European Conference on Corrosion. Rueil-Malmaison; Societe de Chimie Industrielle (1973). (In French).

From 5th European conference on corrosion; Paris, France (24 Sep 1973).

A comparative study was conducted of the corrosion behavior of pure, (2-to-4 percent) hafnium-alloyed, and (down to 100 to 200 ppM) dehafniated zirconium, as well as of various binary zirconium alloys with other alloying elements, in hydrochloric and sulfuric media. The results include the finding that, in pure, concentrated, boiling HCL, zirconium displays a remarkable corrosion resistance. The corrosion resistance in sulfuric acid is excellent at acid concentrations up to 79 percent for room temperature and up to 68 percent for boiling temperature. (IAA)

21613 OXYGEN CORROSION OF SINGLE-PHASE NICKEL–NIOBIUM ALLOYS. Soustelle, M.; Lalauze, R. (Ecole Nationale Superieure des Mines, Saint-Etienne, France). pp 47-48 of Proceedings of the Fifth European Conference on Corrosion. Rueil-Malmaison; Societe de Chimie Industrielle (1973). (In French).

From 5th European conference on corrosion; Paris, France (24 Sep 1973).

An experimental study of the effect of oxidation on alpha-, beta-, and gamma-phase nickel–niobium alloys was conducted. The study was performed at a temperature of 820°C under oxygen pressures varying from 1 to 250 torr for a maximum oxidation time of 24 h. In the case of the alpha solid solution the presence of a very homogeneous external layer consisting of nickel oxide with a small amount of dissolved niobium and an internal layer composed of nickel niobate aggregates in the nickel oxide phase is noted. The presence of this compound, which is not the product of a direct reaction between the gas and the niobium, leads to the conclusion that it came from an initially formed diniobium pentoxide. In the case of the beta and gamma solid solutions at gas pressures above 15 torr oxidation is characterized by the formation of alpha-phase diniobium pentoxide, while at pressures below 15 torr it is characterized by the formation of beta-phase diniobium pentoxide. (IAA)

21614 EFFECT OF LANTHANUM AND YTTRIUM ON THE CORROSION RESISTANCE OF CHROMIUM IN SULFURIC ACID. Tavadze, F. N.; Milkadze, O. I.; Rudol, A. P.; Mandzhgaladze, S. N. Metal Sci. Heat Treat. (USSR) (Engl. Transl.); 16: No. 1-2, 122-124(1974).

Translated from Metalloved. Term. Obrab. Metal; 16: No. 2, 28-30(Feb 1974).

The effects of La and Y on the corrosion resistance of Cr in H_2So_4 solutions at 20 and 100°C were investigated. It was found that the characteristic feature of the corrosion of chromium alloys with lanthanum and yttrium in sulfuric acid solutions is the maximum rate at the beginning of the testing period, followed by stabilization. Lanthanum and yttrium are anodic inclusions and are etched in sulfuric acid. The structure of the matrix has no effect on the corrosion resistance of chromium alloys in 50% sulfuric acid but a substantial effect in 30% sulfuric acid. The addition of 0.28% Y activates chromium, while the addition of 0.68% La does not disturb its passitivity at room temperature. (auth)

21615 BORIDING OF TOOL STEELS IN COMMERCIAL BORON CARBIDE. Permyakov, V. G.; Loskutov, V. F.; Trush, I. Kh.; Pisarenko, V. N. (Polytechnical Inst. Kiev). Metal Sci. Heat Treat. (USSR) (Engl. Transl.); 16: No. 1-2, 160-162(1974).

Translated from Metalloved. Term. Obrab. Metal; 16: No. 2, 56-58(Feb 1974).

The kinetics of formation, composition, and properties of diffusion coatings produced by boriding tool steels were studied. To improve the operating characteristics it is recommended that steels U8, U12, 9KhS, KhVG, ShKh15, and 5KhGM be borided at 920°C for 4 h, and steels Kh12, Kh12M, 3Kh2V8, and 4Kh4M2VFS at 1050°C for 2 h. (auth)

21616 EFFECT OF LIQUID BORIDING ON THE SURFACE QUALITY OF ALLOY KhN77TYuR. Akulinichev, E. V.; Akulinicheva, A. N.; Mosin, N. I. (N. E. Bauman Tech., Coll., Moscow). Metal Sci. Heat Treat. (USSR) (Engl. Transl.); 16: No. 1-2, 163-164(1974).

Translated from Metalloved. Term. Obrab. Metal; 16: No. 2, 58-59(Feb 1974).

The effects of diffusion boriding in a liquid bath composed of 70% borax and 30% boron carbide on the surface quality of alloy KhN77TYuR were investigated. It was found that diffusion boriding may raise or lower the surface finish under certain conditions, depending on the original quality of the surface. (auth)

Preparation and Fabrication

21617 (INIS-mf-1294) RAUFOSS ZIRCALOY CLADDING TUBE. (Raufoss Ammunisjonsfabrikker A/S (Norway)). [nd]. 7p. INIS.

The background for the production of zircaloy cladding tubes by Raufoss Ammunisjonsfabrikker is briefly presented. Data on strength and ductility for the Raufoss product are presented graphically and tube cross sections showing grain size and hydride orientation are illustrated. Surface roughness and dimensional tolerances are also presented graphically. (NO)

21618 (LA-UR-74-937) HIGH RATE PHYSICAL VAPOR DEPOSITION OF REFRACTORY METALS. Sherman, M. A.; Bunshah, R. F.; Beale, H. A. (Los Alamos Scientific Lab., N. Mex. (USA)). 1973. 39p. (CONF-740645-1). Dep. NTIS $5.00.

From vacuum metallurgy conference; Pittsburgh, Pennsylvania, USA (17 Jun 1974).

Foils of Mo, TZM, Nb, and V were produced using high rate physical vapor deposition (HRPVD) techniques on substrates of the same materials. All four were condensed at 0.37 of their melting temperatures T_m, with Mo further studied from 0.23 to 0.44 T_m and TZM from ~0.2 to 0.39 T_m. Deposits were characterized by grain size and morphology, yield strength, impurity content, hardness, bend ductility, and additionally for Mo the lattice parameter and tensile strength. Mo condensed epitaxially on Mo substrates between 600 and 900°C. TZM condensed in a columnar grain morphology with a fibrous substructure, and Nb in an equiaxed structure. Yield strengths of Mo and Nb were comparable to those of conventionally prepared material for equivalent grain sizes. TZM exhibited no mechanical strength due to oxygen contamination during deposition. An average yield strength of 36.1 kg/mm^2 was obtained in V deposits of 0.69 μm grain size. The possibility of suppressing void formation and growth in fast-neutron irradiated fine grained materials produced by HRPVD is discussed. (auth)

21619 (SLA-74-306) SANDIA LABORATORIES TECHNICAL CAPABILITIES: MATERIALS AND PROCESSES SECTION. (Sandia Labs., Albuquerque, N. Mex. (USA)). Jun 1974. Contract AT(29-1)-789. 28p. Dep. NTIS $4.50.

The activities which provide the basis for the materials and processes capabilities within Sandia Laboratories are reported. Selected applications of these capabilities are presented to illustrate the extent to which they can be applied in research and development activities. Specific technical areas which are emphasized include metallurgy, composites, surface characterization and thin films, polymers, ceramics, and high-temperature characterization. These efforts are focused on material application involving structural and electronic materials, thermal and electrical insulation, radiation shields, and shock mitigation. Key elements in these efforts are functionality, reliability, and longevity. (auth)

21620 CURRENT DEVELOPMENTS IN HOT ISOSTATIC PRESSING (HIP) OF TITANIUM. Witt, R. H. (Grumman Aerospace Corp., Bethpage, NY); Paul, O.; Ziobro, M. T.; Barberio, F. D. pp 315-328 of Modern Developments in Powder Metallurgy. Vol. 7. Hausner, H. H. (ed.). Princeton, NJ; Metal Powder Industries Federation (1974).

From 4th international conference on powder metallurgy; Toronto, Canada (15 Jul 1973). See CONF-730718-P8.

The hot isostatic pressing (HIP) process for powder consolidation consists, in essence, of: (a) loading powders into contoured molds, (b) vibratory compaction of the charge, (c) evacuating and sealing the mold assembly, and (d) subjecting the sealed mold to high temperature and pressure in specially designed autoclaves. The results of recent studies on the process parameters and properties of experimental titanium alloy configurations consolidated in vitreous molds using the hot isostatic pressing (HIP) process are presented. These studies were conducted utilizing five representative grades of Ti–6Al–6V–2Sn and Ti–6Al–4V powders manufactured by the rotating electrode process (REP) and hydride/dehydride processes. It was found that HIP parameters can be designed to obtain 100% densification and that the mechanical properties of some HIP'd configurations are comparable to forgings. The potential for the HIP process in the manufacturing of forging preforms, final configurations, and upgrading of existing castings and welds is outlined. (auth)

21621 DEVELOPMENT OF AN IMPROVED OXIDATION RESISTANT DISPERSION STRENGTHENED NICKEL–CHROMIUM ALLOY. Timbres, D. H.; Norris, L. F.; Clegg, M. A.; Evans, D. J. I. (Sherritt Gordon Mines Ltd., Fort Saskatchewan, Alberta, Canada). pp 391-418 of Modern Developments in Powder Metallurgy. Vol. 7. Hausner, H. H. (ed.). Princeton, NJ; Metal Powder Industries Federation (1974).

From 4th international conference on powder metallurgy; Toronto, Canada (15 Jul 1973). See CONF-730718-P8.

Preparation of dispersion strengthened Ni-base alloy by powder metallurgy is described. The alloy (Ni/16Cr/5Al/2ThO_2) has excellent oxidation and sulfidation resistance at temperatures up to 1200°C under a wide variety of environmental conditions. The addition of 0.2% yttrium to the matrix provided increased adhesion of the protective surface oxide (Al_2O_3) under thermal cycling. At temperatures from 25 to 980°C the Ni/16Cr/5Al/2ThO_2 alloy was

stronger than the reference Ni/Cr/ThO_2 alloy and at higher temperatures the alloys had similar strengths (90 MNewtons/m^2 at 1093°C). The 100 h stress-rupture life of the alloy at 1093°C was 51.8 MNewtons/m^2 and 38.0 MNewtons/m^2 in the longitudinal and transverse directions respectively. (auth)

21622 POWDER METALLURGY PROCESSING OF ASTROLOGY TURBINE DISKS. Evans, D. J.; Duhl, D. N.; Slack, R. B. (Pratt and Whitney Aircraft, Middletown, CT). pp 473-490 of Modern Developments in Powder Metallurgy. Vol. 7. Hausner, H. H. (ed.). Princeton, NJ; Metal Powder Industries Federation (1974).

From 4th international conference on powder metallurgy; Toronto, Canada (15 Jul 1973). See CONF-730718-P8.

Two approaches to disk fabrication using inert gas atomized Astroloy powder are described. In one process high pressure hot isostatic pressing (HIP) is used to form cylindrical billets while in the second process low pressure HIP is used to consolidate toroidal forging preforms. (JRD)

21623 METHOD OF OBTAINING TUNGSTEN COATINGS. Golovanov, Yu. N.; Krasovskii, A. I.; Pleshakov, V. S.; Turner, A. Kh. USSR Patent 316,759. 22 Dec 1971. Filed Date 10 Jul 1969. vp.

Coatings are obtained by reduction of WF_6 with H_2, with application of acoustic vibrations to improve coating quality and to accelerate deposition. A workpiece is heated to 700 to 750° in a H_2 flow, after which WF_6 and H_2 are supplied at a ratio of 1:15 to 1:20 with simultaneous application of 0.15 to 18 kHz, 80 to 140 db sound. The coatings have a fine-grain structure, high adhesion to the substrate, and uniform thickness when applied to a workpiece with a complex configuration. (Corrosion Abstr.)

21624 PURIFICATION OF TUNGSTEN MONOCRYSTALS DURING GROWTH FROM PLASMA ARC MELTS. Savitskii, E. M.; Burkhanov, G. S.; Raskatov, N. N.; Doron'kin, E. D.; Sergeev, N. N. Tsvetn. Metal.; No. 3, 35 to 38(Mar 1974). (In Russian).

W monocrystals having a diameter of ≤ 50 mm and a weight of >10 kg were produced. The proposed mechanism for the removal of carbon was examined. The most effective purification was obtained after double remelting in an atmosphere of Ar and He at growth rates of 1.5 to 4 mm/min. (tr-auth)

21625 SUPERALLOYS: PROCESSING. Proceedings of the Second International Conference, Champion, Pennsylvania, September 18–20, 1972. Columbus, OH; Battelle Columbus Laboratories (1972). 435p. (MCIC-72-10; CONF-720917-). NTIS $21.95.

Twenty-eight papers are presented on the processing of superalloys with emphasis on Ni-base alloys and turbine materials. Separate abstracts were prepared for 25 of the papers. (DLC)

For abstracts of individual papers see: 21626–21640 and 21727–21736.

21626 MELTING AND REFINING TECHNOLOGY OF HIGH-TEMPERATURE STEELS AND SUPERALLOYS: A REVIEW OF RECENT PROCESS DEVELOPMENTS. Schlatter, R. (Latrobe Steel Co., PA). pp A1-A40 of Superalloys: Processing. Columbus, OH; Battelle Columbus Labs. (1972).

From second international conference on superalloys-processing; Champion, Pennsylvania, USA (18 Sep 1972).

See MCIC-72-10; CONF-720917-.

The recent increase in number and capacity of melting and refining processes is related to the increasing use of high-temperature alloys in wrought and cast form and to the fact that the potential of conventional processes has been largely exhausted. The evolution of the major melting processes for high-performance materials and the trend toward separation of modern melting and refining operations into distinctive individual functions are outlined. Use of auxiliary refining equipment after air melting is attractive for specialty steels and also for nickel-base alloys. Some of the auxiliary refining technologies are described in the light of their use for degassing, desulfurization, carbon deoxidation, precise alloying, and decarburization. Metallurgical process characteristics, features, and shortcomings of various production and pilot melting techniques are compared with each other. The present wrought alloy processes provide flexibility in the selection of melting processes. Emphasis is placed on the double vacuum melting process which combines vacuum induction melting and vacuum arc remelting. Electroflux remelting in combination with air melting or vacuum induction melting is used as an alternative process to vacuum arc remelting. Metallurgical, operational, and quality aspects of the production melting techniques are discussed regarding raw material selection, composition and impurity control, refining capabilities, and control of ingot structures. Electron beam melting and the promising plasma arc melting process are considered. An outlook into the future position of the various melting and refining schemes concludes the review. (48 references, 6 tables, 10 figures) (DLC)

21627 EFFECTIVE ELECTROSLAG REMELTING OF SUPERALLOYS. Klein, H. J.; Pridgeon, J. W. (Cabot Corp., Kokomo, IN). pp B1-B26 of Superalloys: Processing. Columbus, OH; Battelle Columbus Labs. (1972).

From second international conference on superalloys-processing; Champion, Pennsylvania, USA (18 Sep 1972).

See MCIC-72-10; CONF-720917-.

It is necessary to optimize the most important properties, such as structure, chemical uniformity, and inclusion control by careful choice of the remelt parameters. The relationship between these properties and possible remelt variables such as melt mode, power level, slag chemistry and furnace atmosphere for various types of superalloy are reviewed and discussed. From the processing viewpoint, the differences between molten and solid slag starting are discussed as well as the effects of ingot structure and ingot surface on forgeability. The potential differences and similarities between the electroslag remelting process and the vacuum arc remelting process are considered and discussed. (12 figures, 11 tables) (auth)

21628 INVESTMENT CASTING OF SUPERALLOYS. Hockin, J. (Hockin Associates, Chicago). pp C1-C9 of Superalloys: Processing. Columbus, OH; Battelle Columbus Labs. (1972).

From second international conference on superalloys-processing; Champion, Pennsylvania, USA (18 Sep 1972).

See MCIC-72-10; CONF-720917-.

The investment casting process for making complex shapes in difficult-to-machine alloys is a development of the ancient lost wax process for making metal replicas of wax sculptures. The major use for this process is in the manufacture of turbine blades and vanes. Control of grain size and of mechanical properties (by use of Hf oxide) and some problems are discussed. (DLC)

21629 MANUFACTURE OF HEAT-RESISTING STEEL CONTAINING HIGH CONCENTRATION OF NITROGEN AND ITS HIGH TEMPERATURE PROPERTIES. Tanaka, R.; Shinoda, T.; Tobe, Y. (Tokyo Inst. of Tech.). pp E1-E17 of Superalloys: Processing. Columbus, OH; Battelle Columbus Labs. (1972).

From second international conference on superalloys-processing; Champion, Pennsylvania, USA (18 Sep 1972).

See MCIC-72-10; CONF-720917-.

To utilize nitrogen as an alloying element in heat-resisting steels, an experimental study was made on the fundamental phenomena occurring in melting and casting of various high-chromium steels under high-pressure nitrogen atmosphere. By this technique, sound ingots containing high concentration of nitrogen could practically be obtained, and new high-strength heat-resisting steels could be developed, some of whose creep-rupture strength at 700°C -10^3 h far exceed 20 kg/mm^2 with an excellent high-temperature ductility. Effects of Mo and W additions were also investigated. (10 figures) (auth)

21630 HOT WORKING BEHAVIOR OF SUPERALLOYS ACCORDING TO VARIOUS TYPES OF HOT WORKABILITY TESTS. Cremisio, R. S. (RSC Materials Tech. Associates, Clinton, NY); McQueen, H. J. pp G1-G36 of Superalloys: Processing. Columbus, OH; Battelle Columbus Labs. (1972).

From second international conference on superalloys-processing; Champion, Pennsylvania, USA (18 Sep 1972).

See MCIC-72-10; CONF-720917-.

A brief review of the various types of hot-workability tests is made. Included for discussion are cylinder upset, cast cone, wedge reduction, tensile impact, hot tensile, hot compression, Gleeble, and cam plastometer. Some correlation of these tests with temperature, strain rate, and structure is made. A discussion of the deformation modes related to some specific alloy types is undertaken, including matrix-stiffened, precipitation-strengthened, and phase-transformation-strengthened alloys. Yield phenomenon, deformation stresses, static and dynamic recovery, and recrystallization mechanisms are correlated with these alloy systems. The role of substructures is briefly discussed as to possible mechanisms related to superalloy service. The above will hopefully yield a better understanding of important testing criteria, the tolerances in their control, and the use of these specific hot working tests to control critical parameters associated with hot working operations. (38 references, 4 tables, 18 figures) (DLC)

21631 HOT-WORKABILITY OF INCONEL 600 AND HASTELLOY X. Sakakibara, M.; Sekino, S. (Technical Research Inst., Kitakyushu, Japan). pp I1-I9 of Superalloys: Processing. Columbus, OH; Battelle Columbus Labs. (1972).

From second international conference on superalloys-processing; Champion, Pennsylvania, USA (18 Sep 1972).

See MCIC-72-10; CONF-720917-.

The hot-workability of Inconel 600 and Hastelloy X was investigated, varying the melting practices, minor elements, impurities. It was improved by decreasing Cu and Mn content, by adding B, Be, Zr and Ce, by decreasing inclusions, and by decreasing γ grain

size. The effective processes for its improvement were electroslag remelting, refining under vacuum, diffusion-annealing, and increase of forging ratio. (18 figures) (auth)

21632 TMP: ITS EFFECT ON TURBINE HARDWARE. Couts, W. H. Jr.; Coyne, J. E. (Wyman-Gordon Co., Worcester, MA). pp K1-K20 of Superalloys: Processing. Columbus, OH; Battelle Columbus Labs. (1972).

From second international conference on superalloys-processing; Champion, Pennsylvania, USA (18 Sep 1972).

See MCIC-72-10; CONF-720917-.

Thermomechanical processing (TMP) is considered as the deliberate mating of deformation and heat treatments to achieve specific mechanical property goals. The conception and birth of TMP is traced from the early 1950's involving the 16-25-6 and A-286 alloy turbine wheels through today's heavily TMP-dependent turbine components. Major significance is associated with processing changes which occurred in Astroloy in the early 1960's. Both older and newer turbine alloys have been influenced by this revolution. The degree of change is quite evident in the mechanical property requirements for today's turbine hardware. The supremacy of tensile and stress-rupture strength is being challenged by creep, low cycle fatigue, fracture toughness, and microstructure. Examples are given of Inco 718, Waspaloy, Astroloy, and Rene' 95 in both solid and powder form. (16 references, 4 tables, 9 figures) (auth)

21633 MINIGRAIN™ PROCESSING OF NICKEL-BASE ALLOYS. Brown, E. E.; Boettner, R. C.; Ruckle, D. L. (Pratt and Whitney Aircraft, East Hartford, CT). pp L1-L12 of Superalloys: Processing. Columbus, OH; Battelle Columbus Labs. (1972).

From second international conference on superalloys-processing; Champion, Pennsylvania, USA (18 Sep 1972).

See MCIC-72-10; CONF-720917-.

It was previously determined that during thermomechanical processing of Incoloy 901, a refinement in grain size from ASTM 2 to ASTM 5 resulted in improved fatigue capability. A study was conducted on Incoloy 901 and Inconel 718 to determine whether further grain size reductions with improved fatigue properties were possible. A process, called the MINIGRAIN™ Process, was developed for attaining grain structures finer than ASTM 10. In the process, a dispersion of spheroidal intermetallic phases is established which minimizes grain growth during the subsequent recrystallization. The processing sequence used to attain the MINIGRAIN structure in Incoloy 901 and Inconel 718 is described along with the grain size effects on the tensile, fatigue, and creep behavior. (4 tables, 5 fig) (DLC)

21634 HIGH-TEMPERATURE PROPERTIES OF WELDED CAST Co-BASE ALLOYS. Chase, T. F.; Beltran, A. M. (General Electric Co., Schenectady, NY). pp R1-R23 of Superalloys: Processing. Columbus, OH; Battelle Columbus Labs. (1972).

From second international conference on superalloys-processing; Champion, Pennsylvania, USA (18 Sep 1972).

See MCIC-72-10; CONF-720917-.

The weldability of contemporary cast Co-base superalloys used in gas turbine vane applications is reviewed. Weldments were produced in two different strength-level alloys, FSX-414 and MM-509, using the Gas-Tungsten-Arc (GTA) and Electron Beam (EB) processes. Hot-cracking tendencies were evaluated as a function of filler alloy for GTA weldments. The response to post-weld solution treatment was measured by transverse-weld tensile and stress-rupture tests. Weldments were also subjected to service-simulated oxidation and hot-corrosion atmospheres in a small combustion burner rig. Fluidized-bed thermal fatigue testing was conducted on weldments utilizing Glenny-type tapered discs. Crack initiation and propagation data were obtained on smooth and notched configurations, respectively. (8 tables, 13 figures) (auth)

21635 PLASMA-ARC WELDING OF AN ISOTOPE CAPSULE. Goodwin, G. M.; Early, B. F. (Oak Ridge National Lab., TN). pp S1-S15 of Superalloys: Processing. Columbus, OH; Battelle Columbus Labs. (1972).

From second international conference on superalloys-processing; Champion, Pennsylvania, USA (18 Sep 1972).

See MCIC-72-10; CONF-720917-.

A certain thermoelectric generator uses a ^{90}Sr titanate fuel form in a heavy-walled Hastelloy C capsule. The capsule design uses a threaded end cap, with a closure weld to ensure containment. Based upon maximum anticipated seawater corrosion rates, a minimum weld penetration of 0.055 in. is required. Autogeneous gas tungsten-arc (GTA) welding has been used to produce the closure weld in a remote hot-cell environment; however, in the case of certain weldment designs and materials, the attainment of the required penetration by GTA welding presented problems. A plasma-arc welding procedure was developed and successfully applied to four fueled capsules, achieving an average penetration of at least twice the minimum requirement. The plasma process was found to be relatively insensitive to several of the variables which greatly affect penetration in the GTA process. The advantages of the plasma welding process for this application are listed. (9 figures) (auth)

21636 STATE OF TECHNOLOGY FOR JOINING TD-NiCr SHEET. Holko, K. H.; Moore, T. J.; Gyorgak, C. A. (National Aeronautics and Space Administration, Cleveland). pp T1-T35 of Superalloys: Processing. Columbus, OH; Battelle Columbus Labs. (1972).

From second international conference on superalloys-processing; Champion, Pennsylvania, USA (18 Sep 1972).

See MCIC-72-10; CONF-720917-.

At the current state-of-technology there are many joining processes that can be used to make sound welds in TD-NiCr sheet. Some of these that are described are electron beam welding (EBW), gas-tungsten arc welding (GTAW), diffusion welding (DFW), resistance spot welding (RSW), resistance seam welding (RSEW), and brazing. Roll welding (RW) and explosion welding (EXW) have not been developed to the point where they can be used to make sound welds in TD-NiCr. The strengths of the welds made by the various processes show considerable variation, especially at elevated temperatures. Most of the fusion welding processes tend to give weak welds at elevated temperatures (with the exception of fusion-type resistance spotwelds). However, solid-state welds have been made with parent metal properties. The process used for a specific application will be dictated by the specific joint requirements. For example, if a particular joint will never be highly stressed at elevated temperatures, fusion welding processes may be satisfactory. In highly stressed joints at elevated temperatures, one of the solid-state processes, such as DFW, RSW (solid-state or fusion), and RSEW, offer the most promise. Joining work that has previously been done on TD-NiCr is described in this summary. Current work is also described that is being done at General Dynamics/Convair (under NASA contract) and at NASA/Lewis to develop and evaluate DFW, RSW, RSEW, and brazing. Preliminary comparisons of joining processes are made for typical applications. A brief description of the manufacture of TD-NiCr sheet by a recently standardized process (under NASA contract) also is given. (20 figures, 7 tables) (auth)

21637 COMPARISON OF ASTROLOY POWDER CONSOLIDATION PROCESSES: FORGING AND TESTING OF ASTROLOY POWDER BILLET. Morris, C. A. (Wyman-Gordon Co., North Grafton, MA); Smythe, J. W. pp Y1-Y26 of Superalloys: Processing. Columbus, OH; Battelle Columbus Labs. (1972).

From second international conference on superalloys-processing; Champion, Pennsylvania, USA (18 Sep 1972).

See MCIC-72-10; CONF-720917-.

A heat of Astroloy powder was produced and consolidated into billet by three different techniques: hot isostatic pressing at two different temperatures, extrusion using an 8 : 1 ratio, and forge compaction. The resulting eight powder billets were then upset forged along with two VAR billets in three operations. The pancakes so produced were heat treated at temperatures which gave partial and full gamma prime solutioning. Tensile, combination stress rupture, creep, and LCF tests were performed from each billet. These test results are reported along with optical and electron micrographs of each billet. (12 tables, 6 figures) (auth)

21638 PROPERTIES OF In-100 PROCESSED BY POWDER METALLURGY. Moskowitz, L. N.; Pelloux, R. M.; Grant, N. J. (Massachusetts Inst. of Tech., Cambridge). pp Z1-Z25 of Superalloys: Processing. Columbus, OH; Battelle Columbus Labs. (1972).

From second international conference on superalloys-processing; Champion, Pennsylvania, USA (18 Sep 1972).

See MCIC-72-10; CONF-720917-.

A powder metallurgy approach to the production of IN-100 is shown to result in a fully dense, homogeneous alloy with excellent hot-workability. Small billets were prepared by compacting metal powders processed by inert-gas atomization, vacuum-atomization, and the rotating electrode process. The different powders are characterized by scanning electron microscopy, and size distributions as well as dendrite arm spacings are presented. Compaction of the powders was done by hot isostatic pressing and by hot extrusion. The mechanical properties of different billets are compared to the cast IN-100 as a function of the processing variables. Characterization of the hot workability of the powder processed IN-100 is first done by high-strain rate testing, and finally by an investigation of the superplastic behavior at low strain rates in the temperature range from 1800 to 2100°F. The rate of grain coarsening at 2270°F is shown to depend upon the size and amount of titanium carbide phase at the prior particle boundaries. The excellent low-temperature properties of IN-100 processed by powder metallurgy are related to the refinement of the grain size and microstructure and breakdown of powder particle films obtained during atomization and hot extrusion. The stress-rupture properties at 1800°F, which are strongly dependent upon the grain size obtained

during the 2270°F coarsening heat treatment, are slightly inferior to the properties of the cast alloy. (22 figures) (auth)

21639 EFFECT OF PROCESSING VARIABLES ON POWDER-METALLURGY RENE 95. Barker, J. F.; VanDerMolen, E. H. (General Electric Co., Cincinnati). pp AA1-AA23 of Superalloys: Processing. Columbus, OH; Battelle Columbus Labs. (1972).

From second international conference on superalloys-processing; Champion, Pennsylvania, USA (18 Sep 1972).

See MCIC-72-10; CONF-720917-.

A Rene 95 powder-metallurgy processing study was conducted for producing Rene 95 disks and the effects of powder-processing variables on properties and producibility. Variables studied included powder manufacturing method (argon atomization, rotating electrode, and H_2 vacuum atomization), particle-size distribution, consolidation techniques (extrusion vs HIP), forging reductions and temperatures, and heat-treatment schedules. Decreases in powder particle size resulted in increases in 1200°F stress-rupture lives of both extruded and HIP consolidated powders. Tensile properties of extruded compacts were superior to HIP properties and were unaffected by prior particle size while HIP compact tensile properties were inversely proportional to powder size. Subsequent forging of the compacts greatly minimized differences caused by the original powder size distribution and resulted in comparable tensile strengths for both consolidation methods. Stress-rupture lives and ductilities, however, were superior for the HIP forgings. Forging at lower temperature (1975F vs 2075F) and at higher forging reductions improved tensile properties. Forgeability of the consolidated powders was good for virtually all conditions. In summary, the best powder metallurgy forging properties were achieved using powders having a fine particle size distribution that were consolidated at 2090F (below γ' solvus) and forged at 1975F. (10 figures, 6 tables) (auth)

21640 POWDER METALLURGY PRODUCTS FOR ADVANCED GAS TURBINE APPLICATIONS. Ewing, B.; Rizzo, F.; zurLippe, C. (Avco Lycoming Div., Stratford, CT). pp BB1-BB20 of Superalloys: Processing. Columbus, OH; Battelle Columbus Labs. (1972).

From second international conference on superalloys-processing; Champion, Pennsylvania, USA (18 Sep 1972).

See MCIC-72-10; CONF-720917-.

Powder metallurgy activity has focused upon a series of high-strength nickel-base superalloys. Modifications of IN792 were developed for turbine disc applications where high strength-to-density properties are of interest. The alloy powders used for these development efforts carry the Lycoming designation of PA 101. Production of the powders was by argon gas atomization; after consolidation by extrusion and subsequent forging operations, oxygen levels were determined to be less than 100 ppM. With this approach, processing conditions were developed that resulted in turbine discs which exhibited mechanical properties superior to those of conventionally processed D979, Inconel 718, and Rene 95. In addition, workability and alloy homogeneity were determined to be excellent. Results are presented in terms of microstructure, tensile, stress rupture, and low-cycle fatigue properties. (23 figures) (auth)

21641 SEMIFINISHED AND UNFINISHED BERYLLIUM PARTS. Strassmann, I. Metal.; 28: No. 3, 245-250(Mar 1974). (In German).

5 figs.; 6 tabs.; 13 refs.

Recent developments in the field of materials technology in general and in particular the advances achieved in powder metallurgy, have led to the development of a number of methods for the production of semi-finished beryllium parts from powder for a variety of applications. These methods have been devised not only to comply with the technical specification set up by the user of these parts, but also a view to economic and manufacturing requirements. The process of producing beryllium powders and semi-finished beryllium parts is described. Some of the disadvantageous properties of beryllium which have been an impediment so far in the application of beryllium could be reduced considerably by improving the processing methods. (GE)

21642 EFFECT OF PARAMETERS OF GAS FLAME METALLIZATION ON THE STRUCTURE AND PROPERTIES OF MOLYBDENUM COATINGS. Protasov, G. A. Weld. Prod. (USSR) (Engl. Transl.); 20: No. 3, 10-13(Mar 1973).

Translated from Svar. Proizv.; 20: No. 3, 6-7(Feb 1973).

In the factorial space region studied, the spraying parameters have a statistically significant effect on the hardness and porosity of the molybdenum coatings. The effect on microstructure and tensile strength is insignificant. The hardness can be increased by using a higher air pressure, increasing the oxygen content of the combustible mixture, reducing the rate of displacement of the jet, and increasing the spraying distance. (auth)

21643 STRENGTH OF BRAZED JOINTS IN SHEET MOLYBDENUM. Osintsev, O. E. Weld. Prod. (USSR) (Engl. Transl.); 20: No. 3, 69-72(Mar 1973).

Translated from Svar. Proizv.; 20: No. 3, 37-39(Feb 1973).

The low strength of brazed joints operating in tension is connected with the extremely low strength of molybdenum alloys through the sheet thickness. The strength of molybdenum alloys through the sheet thickness can be increased by recrystallization of the deformed metal, by reduction of the degree of deformation in cold rolling, and by the use of rolling at temperatures above the recrystallization temperature. In brazed assemblies stresses in the direction perpendicular to the plane of the sheet, it is desirable to employ recrystallized molybdenum alloys. (auth)

21644 GRINDING INDUCED MACHINING DAMAGE IN BERYLLIUM. Taylor, W. (Kawecki Billiton Ltd., Slough, Eng.); White, J. S. J. Mater. Sci.; 9: No. 4, 569-575(Apr 1974).

An investigation has been made of the machining damage induced in beryllium by surface grinding. A series of damage free specimens was prepared from a bar extruded from a block of hot-pressed beryllium powder. Each specimen was then ground on one large surface using a different set of grinding conditions, as dictated by the requirements of a quarter-replicate factorial experiment which involved eight grinding parameters each taken at two levels. The damage induced by the surface grinding was evaluated by testing each specimen in a four point bending mode. The tests were conducted so that the maximum tensile strain due to bending occurred at the experimentally ground surfaces. A statistical analysis of the results enabled the grinding conditions giving rise to the least and the greatest amount of machining damage to be predicted. In a second series of experiments, these predictions were found to correlate with the metallographically observable damage and the mechanical test data obtained from a further series of bend test specimens. (auth)

21645 PROCESSING OF EUTECTIC BLADES. Graham, L. D. pp 107-114 of Conference on in situ Composites. Vol. I. Washington, DC; National Academy of Sciences (1973).

From conference on in situ composites; Lakeville, Connecticut, USA (5 Sep 1972). See NMAB-308-1; CONF-7209117-P1.

Equipment was designed to directionally solidify single turbine blades. Solidification parameters were investigated using the eutectic alloy Ni_3Al-Ni_3Nb and conventional investment casting molds. The effect of solidification variables was determined on the macro-grain alignment and the microstructure through the length of the airfoil. Reactivity of the alloy with both a zircon mold and a silica core was controlled so that aligned structures resulted. (auth)

21646 INVESTIGATION OF PROCESS OF ELECTRODEPOSITION OF Co-Mo ALLOYS FROM COMPLEX ELECTROLYTES. I. Influence of Some Factors on the Properties and Composition of Deposits Obtained from Citrate Electrolytes. Kaushpedas, Z. P.; Babyalis, Yu. S.; Byarnotas, A. K.; Gladkov, N. M. (Inst. of Chemistry and Chemical Technology, Vilnyus, USSR). Liet. TSR Mokslu Akad. Darbai, Ser. B; 1: No. 80, 27-32(1974). (In Russian).

The current efficiency amount of Mo in deposits, inclusions, internal stresses, and cathodic polarization of the indicated alloys were investigated as a function of conditions of electrolysis and composition of electrolyte. It was determined that deposits of Co, depending on electrolysis conditions, have 2% inclusions. In all cases, additions of Na_2NoO_4 to electrolyte increases the amount of inclusions in the deposits. Larger amounts of inclusions in the deposits were obtained on decreasing the ligand concentration. The amount of Mo in the deposits depends on the concentration of Na_2NoO_4 and ligand in the electrolyte and on the electrolysis conditions. Increasing concentration of Na_2MoO_4 and i_k current efficiency decreases. The measured internal stresses of deposits of Co-Mo alloys, obtained using a current density for Co lower than the limiting one, are smaller than those obtained using a current density higher than the limiting one. (auth)

Properties, Structure, and Phase Studies

Refer also to abstracts 20692, 21021, 21421, 21510, 21511, 21547, 21568, 21569, 21840, 22463, and 22534.

21647 (AEC-tr-7408) RARE EARTH METALS AND ALLOYS. Savitskii, E. M.; Terekhova, V. G. (eds.). 1974. Translation of Redkozemel'ne Metally i Splavy, Izdatel'stvo Nauka, Moscow, 1971. (TT-73-58024). 106p. Dep. NTIS $8.50.

A compilation of thirty-four papers on rare earths, rare earth alloys, and rare earth compounds is presented. (JRD)

21648 (AED-CONF-74-063-001) INFLUENCE OF DISSOLVED OXYGEN AND NITROGEN ON THE YIELD STRENGTH OF ZIRCONIUM AND HAFNIUM. Ruano, O.; Eissner, G. (Max-

Planck-Institut fuer Metallforschung, Stuttgart (F. R. Germany). Inst. fuer Werkstoffwissenschaften). 1974. 5p. (In German). INIS.

From conference on gases in metals; Darmstadt, Germany (7 Mar 1974).

Tensile tests have been made on wire-shaped samples using a 5-ton testing machine in order to determine the yield strength. The tests have been carried out in the temperature range between 77 and 500°K at deformation rates from 6.9×10^{-7} up to 6.5×10^{-4} sec^{-1}. The samples have been subjected to volumetrically controlled gas treatment prior to the testing in order to be able to determine the yield strength as a function of oxygen and nitrogen concentration in the samples. The gas concentrations varied between 0.15 and 1.4 at. %. The yield strength has been found to rise with increasing concentration of interstitial impurity atoms, decreasing temperature, and increasing strain rate. For polycrystalline Hf samples, a linear relationship between yield strength and gas concentration has been found, whereas Zr samples showed a curvilinear dependence. In both materials, however, oxygen produced a markedly stronger hardening than nitrogen. For a theoretical interpretation of the experimental data, activation parameters have been measured on the basis of which a theoretical model has been developed for accurate description of the measured results. (INIS)

21649 (AED-CONF-74-089-017) DISLOCATION DAMPING IN HIGH-PURITY TANTALUM SINGLE CRYSTALS. Knoblauch, G.; Benoit, W.; Schultz, H. 1974. 7p. (In German). INIS.

From spring meeting of the working group solid state physics of the Deutsche Physikalische Gesellschaft e.V.; Freudenstadt, F. R. Germany (1 Apr 1974).

6 figs.; 9 refs.

In order to gain more insight into the plastic behavior of pure tantalum, the contributions of dislocations to the internal friction and the modulus defect were measured in high-purity tantalum single crystals in the temperature range between 60 and 360°K. The dependence of the α-peak in the damping spectrum on the degree of deformation and the deformation temperature is discussed in particular. Low-temperature deformation is found to produce an α-peak three times higher than that of high-temperature deformation, from which it is concluded that the relaxation mechanism observed is determined by screw dislocations. The maximum of the α-peak, however, is found at higher temperatures. From the data obtained for the α-peak, from the frequency and maximum temperature, an activation energy of 0.25 eV and a pre-factor of 9×10^8 Hz have been determined. A comparison with literature data obtained on samples of lower purity shows that interstitial impurities do have an effect on the frequency factor but do not affect the activation energy. (GE)

21650 (CEA-R-4565) TRACER DIFFUSION STUDY IN BINARY ALLOYS. Bocquet, J. L. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France)). Jul 1974. 98p. (In French). Dep. NTIS (US Sales Only) $8.00.

Thesis. Submitted to Paris Univ., Orsay (France). Faculte des Sciences.

The diffusional properties of dilute alloys are well described by 5 vacancy jump frequencies, however, results of diffusion experiments allow this determination using only 3 jump frequency ratios. The first experiment set, found by Howard and Manning, was used in order to determine the 3 frequency ratios in the dilute Cu–Fe alloy. N. V. Doan has shown that the isotope effect measurements may be replaced by easier electromigration experiments; this new method was used with success for the dilute Ag–Zn and Ag–Cd alloys. Two reactions which take place in less dilute alloys cannot be explained using the 5 frequency model, these are: the linear enhancement of solute diffusion and the departure from linear enhancement of solvent diffusion versus solute concentration. To explain these reactions, the effects of solute pairs on diffusion via 53 new vacancy jump frequencies must be taken into account. Diffusion in a concentrated alloy can be described using a quasi-chemical approach. It is shown that a description incorporating surrounded atoms allows the simultaneous explanation of the thermodynamic properties of the binary solid solution and the dependence of atomic jump frequencies with respect to the local concentration of the alloy. In this model, the two atomic species have a jump frequency spectrum at their disposal, which seems to greatly modify Manning's correlation analysis. (auth)

21651 (CEA-R-4566) STUDY OF PHASE TRANSFORMATIONS IN TITANIUM ALLOYS. II. Contribution to the Study of Isothermal Transformations in Ti–6% Al–6% V–2% Sn–Titanium Alloy, After Quenching from ($\alpha + \beta$). Fontalirand, C.; Beauvais, C.; Fidelle, J. P.; Hocheid, B. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92-Montrouge (France)). May 1974. 68p. (In French). Dep. NTIS (US Sales Only) $6.50.

After preheating at 850°C four transformations areas are evidenced: between 850 and 750°C, adjustment of the compositions and amounts of α, β, and γ phases existing at equilibrium above 850°C; between 750 and 650°C same trend but γ disappears; from Ms = 650°C to 500°C, the breakdown of the α' martensite is superimposed on the previous transformations; below 500°C, α' remains stable; the precipitation of ω phase is evidenced by hardness measurements. A systematic relationship has been established between mechanical properties and the structures obtained after selected isothermal holding times. (auth)

21652 (COO-1198-1070) SCIENCE OF MATERIALS. Annual Progress Report. (Illinois Univ., Urbana (USA). Materials Research Lab.). Mar 1974. Contract AT(11-1)-1198. 71p. Dep. NTIS $6.75.

Summaries of research results are presented on structure and magnetic properties of transition metal alloys, phase transformations in thin films, point defect–dislocation interactions, electron microscopy of intermetallic compounds, deformation of composite materials, stress corrosion, precipitation in refractory alloys, solid solutions, NMR in alloys, high pressure properties of matter, anharmonic properties of solids, properties of noble gas crystals, and physics of refractories. (JRD)

21653 (COO-1198-1073) STUDY OF PRECIPITATION IN COPPER + 13 ATOMIC PERCENT BERYLLIUM BY NUCLEAR MAGNETIC RESONANCE AND FIELD ION MICROSCOPY. Yen, A. C. C. (Illinois Univ., Urbana (USA)). Jun 1974. Contract AT(11-1)-1198. 126p. Dep. NTIS $9.50.

Thesis.

A study of precipitation in a copper–beryllium alloy has been carried out by means of nuclear magnetic resonance and field ion microscopy. For the α solid solution the wipe-out-number describing the copper resonance amplitude is found to be 18 for the central transition. Aging data are obtained for Cu + 13 at. % Be at two different temperatures, 280 and 350°C. The aging curves are shown to be consistent with published values of the activation energy for diffusion of Be in Cu. An apparent equilibrium composition of the α-matrix at various temperatures has been evaluated from the NMR absorption intensity in the completely precipitated state. A deviation from the beryllium solvus boundary is observed and found to be a temperature (aging) dependent quantity. A field ion microscope was constructed; various conditions of image gas composition and pressure were tried for imaging pure copper and Cu + 13 at. % Be. Both pure copper and the alloy were successfully imaged. The precipitate in Cu + 13 at. % Be formed at 280°C is observed and its size is found to be in the order of $2 \times 10^4 Å^3$. A thin layer of copper atoms around each precipitate particle is excluded from the observed NMR absorption intensity because of local lattice and electronic effects. Small precipitate particles, such as those observed with the field ion microscope, embedded the α-matrix cause a shift in the equilibrium beryllium concentration in the α-phase. This is expressed by the Thomson–Freundlich equation. Results from this experiment together with the Thomson–Freundlich equation are used to estimate the interface energy. The value obtained, 577 ergs/cm^2, falls reasonably well within the range of known surface energies. The Knight shift of CuBe is measured for the first time; its value $K_{CuBe} = 0.13\%$ is found to be very close to that of CuZn, $K_{CuZn} = 0.15\%$ measured by G. W. West; both compounds have the same crystal structure. (auth)

21654 (COO-1198-1077) LOW TEMPERATURE INTERNAL FRICTION IN THE NIOBIUM–HYDROGEN AND NIOBIUM–OXYGEN–HYDROGEN SYSTEMS. Mattas, R. F. (Illinois Univ., Urbana (USA)). May 1974. Contract AT(11-1)-1198. 93p. Dep. NTIS $7.75.

Thesis.

The motion of hydrogen and the interaction of hydrogen with other defects in niobium have been studied using the pulse-echo technique of internal friction in the temperature range from 80 to 350°K and in the frequency range from 10 to 310 MHz. The onset of hydride precipitation was observed as a sharp increase in the internal friction at the solvus temperature. In addition, relaxations due to hydrogen–dislocation defects, oxygen–hydrogen defects, and oxygen–deuterium defects were found, and evidence was found for the relaxation of single deuterium atoms. Determination of activation enthalpies of motion, pre-exponential frequency factors, and binding enthalpies were made from the observed relaxations. The hydrogen-dislocation defect was found to have a binding enthalpy in the range from 1.3 to 4.1 kcal/mole. The oxygen–hydrogen defect was shown to have a binding enthalpy of 2.0 ± 0.3 kcal/mole and an enthalpy of motion of 3.6 ± 0.3 kcal/mole. The oxygen–deuterium defect was shown to have a binding enthalpy of 3.0 ± 0.4 kcal/mole and an enthalpy of motion of 4.65 ± 0.4 kcal/mole. The defect tentatively identified with single deuterium atoms was shown to have an enthalpy of motion of 2.85 ± 0.6 kcal/mole. (auth)

21655 (COO-3429-22) MAGNETIZATION STUDIES ON $Tm_2Fe_{17-x}Co_x$ AND $Tm_2Fe_{17-x}Al_x$ COMPOUNDS. Narashimhan, K. S. V. L.; Wallace, W. E.; Hutchens, R. D. (Pittsburgh Univ., Pa. (USA). Dept. of Chemistry). 1973. 4p. Dep. NTIS $4.00.

Magnetization studies were carried out on $Tm_2Fe_{17-x}Co_x$ and $Tm_2Fe_{17-x}Al_x$ compounds in the temperature range 4.2 to 1200°K. Tm_2Fe_{17} changes its easy axis of magnetization from the basal plane to c-axis below 85°K. This transition occurs at higher temperatures as cobalt or aluminum is substituted for iron. The c lattice parameter goes through a maximum as a function of x in the $Tm_2Fe_{17-x}Co_x$ ternaries. The results are interpreted in terms of distance dependence of the magnetic interactions and a competition between the sublattice magnetic anisotropy. $Tm_2Fe_3Co_{14}$ has an anisotropy field of 38 kOe and a potential energy product of 43 MOe at room temperature. (auth)

21656 (FOA-4-C-4547-A2) MAGNETISM AND THE LANTHANIDES. Johansson, B.; Rosengren, A. (Foersvarets Forskningsanstalt, Stockholm (Sweden)). Jul 1973. 73p. (In Swedish). Dep. NTIS (US Sales Only) $6.75.

An overall picture is given of the basic mechanisms for the magnetic properties of a material. The origins of the different types of magnetism are described, starting from the atomic exchange interaction. Special attention is given to the properties of the lanthanides which are becoming increasingly important. The rich flora of magnetic structure in these elements (ferromagnetic, paramagnetic, pseudo-ferromagnetic, pseudo-antiferromagnetic, ferrimagnetic, static spin wave and helix structure) is described and discussed from the point of view of atomic and crystal structure. Notes are given on the technological applications of the lanthanides, viz., Welsbach gas mantles, permanent magnets (e.g., Co_5Sm), magnetic bubbles, lasers, photochromics and in the steel industry (small additions to improve the quality of steel). (SW)

21657 (INIS-mf-1356) SOLIDIFICATION MICROSTRUCTURES OF ALUMINUM–URANIUM ALLOYS. Ambrozio Filho, F. (Sao Paulo Univ. (Brazil). Escola Politecnica). 1973. 67p. (In Portuguese). INIS.

The existing theories on the eutectic formation in binary alloys are reviewed. In general they stress the factors which may determine the microstructures, with emphasis on those that control the eutectic morphology. The microstructures of cast aluminum–uranium alloys in the range of 4 to 20% uranium are examined. The solidification was studied both in ingot molds and under controlled unidirectional crystallization. (auth)

21658 (JAERI-M-5651) CREEP-RUPTURE PROPERTIES OF HASTELLOY-X FOR USE AS THE STRUCTURAL COMPONENTS OF OGL-1. Yokoi, S.; Monma, Y.; Fujimura, T.; Kikuyama, T. (Japan Atomic Energy Research Inst., Tokyo). Mar 1974. 27p. (In Japanese). NTIS (US Sales Only).

The creep–rupture properties of Hastelloy X to be used as the structural components of the in-pile gas loop, OGL-1, were studied in air up to 10^4 h at 800, 900, and 1000°C. TIG welded specimen and electron-beam welded specimens were also included. Creep master curves were obtained using the Larson–Miller parameter. The Larson–Miller plot held a straight line only in the stress range of 1.0 to 6.2 kg/mm^2. The TIG welded specimens at 1000°C did not follow the relationship. At low temperatures and high stresses, the cavity-type micro-cracks were observed near the fractured portion, while at high temperatures and low stresses more uniform distribution of the wedge-type micro-cracks were observed. Fine precipitates containing Mo were distributed uniformly in the grain structures in the specimens fractured at 800 and 900°C, while at 1000°C the coarse precipitates containing both Cr and Mo were observed on the grain boundaries. In the TIG welded specimens tested at 1000°C, coarse precipitates containing Mo appeared at the grain boundaries of weld deposit metal, and the existence of the region depleted in Mo was observed near the precipitates. (auth)

21659 (JUL-1045-FF) MODEL CALCULATION FOR THE $\alpha-\alpha'$ PHASE TRANSITION IN METAL–HYDROGEN SYSTEMS. Horner, H.; Wagner, H. (Kernforschungsanlage Juelich G.m.b.H. (F.R. Germany). Inst. fuer Festkoerperforschung). Feb 1974. 52p. Dep. NTIS (US Sales Only) $5.75.

The $\alpha-\alpha'$ ("gas-liquid") part of the phase diagram of hydrogen dissolved in metals is calculated and compared with experiments for H in Nb. The underlying lattice model includes a hard-core repulsion between protons and an elastic interaction mediated by the host metal lattice. The long-range part of this interaction is treated in mean field approximation. For the hard-core repulsion and the microscopic part of the elastic interaction, low-density cluster expansions and Monte-Carlo calculations are investigated. Reasonable agreement with experimental data is obtained if the microscopic contribution of the elastic interaction is properly taken into account. (11 fig.) (auth)

21660 (LBL-2299) INORGANIC MATERIALS RESEARCH DIVISION ANNUAL REPORT, 1973. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Apr 1974. Contract W-7405-eng-48. 257p. Dep. NTIS $7.60.

Brief summaries of individual research projects are reported in sections for four major research areas as follows: (I) Chemistry—Inorganic Chemistry, Solid State Chemistry and Physics, Electrochemistry, Physical Chemistry, and Nuclear Science; (II) Metallurgy—Crystal Imperfections, Theoretical Metallurgy, Relations of Microstructure with Alloy Properties, High Voltage Electron Microscopy, Alloy Design, High Field Superconductivity, Powder Metallurgy, and Advanced Materials; (III) Ceramic Science—High Temperature Reactions, Microstructure and Behavior of Ceramic Materials, and Relations of Microstructure with Properties in Ceramics; (IV) Solid State Physics—Theoretical Solid State Physics, Far Infrared Properties of Solids, Superconductivity, and Experimental Solid State Physics and Quantum Electronics. Most of the information was published previously. A list of 1973 publications and reports follows each section. (JRD)

21661 (N-73-33430) HIGH TEMPERATURE, LOW-CYCLE FATIGUE OF COPPER-BASE ALLOYS IN ARGON. Part 2. Zirconium–Copper at 482, 538, and 593 C. Technical Report, March–May 1973. Conway, J. B.; Stentz, R. H.; Berling, J. T. (Mar-Test, Inc., Cincinnati, Ohio (USA)). Aug 1973. Contract NAS3-16753. 48p. (NASA-CR-121260; MTI-R-3-2-2). NTIS $4.50.

Zirconium–copper ($^1/_2$ hard) was tested in argon over the temperature range from 482 to 593°C in an evaluation of short-term tensile and low-cycle fatigue behavior. The effect of strain rate on the tensile properties was evaluated at 538°C and in general it was found that the yield and ultimate strengths increased as the strain rate was increased from 0.0004 to 0.01/s. Ductility was essentially insensitive to strain rate in the case of the zirconium–copper alloy. Strain-rate and hold-time effects on the low cycle fatigue behavior of zirconium–copper were evaluated in argon at 538°C. These effects were as expected in that decreased fatigue life was noted as the strain rate decreased and when hold times were introduced into the tension portion of the strain-cycle. Hold times in compression were much less detrimental than hold times in tension. (STAR)

21662 (N-74-16209) HIGH TEMPERATURE, LOW CYCLE FATIGUE OF COPPER-BASE ALLOYS IN ARGON. Part 3. Zirconium–Copper; Thermal–Mechanical Strain Cycling, Hold-Time and Notch Fatigue Results. Contractor Report, October–December 1973. Conway, J. B.; Stentz, R. H.; Berling, J. T. (Mar-Test, Inc., Cincinnati, Ohio (USA)). Dec 1973. Contract NAS3-16753. 52p. (NASA-CR-121261; MTI-R-3-2-3). NTIS $4.75.

The low-cycle fatigue characteristics of smooth bar and notched bar specimens (hourglass shape) of zirconium–copper, $^1/_2$ hard, material (R-2 Series) were evaluated at room temperature in axial strain control. Over the fatigue life range from about 300 to 3000 cycles the ratio of fatigue life for smooth bar to fatigue life for notched bar remained constant at a value of about 6.0. Some additional hold-time data for the R-2 alloy tested in argon at 538°C are reported. An analysis of the relaxation data obtained in these hold-time tests is also reported and it is shown that these data yield a fairly consistent correlation in terms of instantaneous stress rate divided by instantaneous stress. Two thermal-mechanical strain cycling tests were also performed using a cyclic frequency of 4.5 cycles per hour and a temperature cycling interval from 260 to 538°C. The fatigue life values in these tests were noticeably lower than that observed in isothermal tests at 538°C. (STAR)

21663 (NP-20044, pp 98-100) POSITRON ANNIHILATION IN V AND Nb. Shiotani, N.; Okada, T.; Sekizawa, H.; Mizoguchi, T. Dec 1973.

21664 (ORNL-SUB-3654-1) CREEP FAILURE UNDER UNIAXIAL AND MULTIAXIAL STRESS CONDITIONS. Annual Report, January 1, 1972–December 31, 1972. R and D Report LR:72:4213-01:1. Schultz, C. C.; Leyda, W. E. (Babcock and Wilcox Co., Alliance, Ohio (USA). Research Center). 15 Mar 1974. 82p. Dep. NTIS $7.75.

Results of studies on accumulation of creep damage and the evaluation of methods of predicting creep failure under conditions of multiaxial stresses and time-dependent loading are presented. The program includes both uniaxial and multiaxial stress-rupture testing with strain-time data obtained throughout each test. During the report period testing was on type 304 stainless steel at a constant temperature of 1100°F. (JRD)

21665 (ORNL-TM-3797) FUELS AND MATERIALS DEVELOPMENT PROGRAM. Quarterly Progress Report for Period

Ending March 31, 1972. Patriarca, P. (Oak Ridge National Lab., Tenn. (USA)). Jun 1972. Contract W-7405-eng-26. 311p. AT.

Research and development are reported on development of oxide fuels, development of breeder reactor fuels, development of neutron-absorber materials, mechanical properties of alloys in reactor environments, fabrication of cladding, compatibility of boiler materials, joining of structural materials, and nondestructive testing. (JRD)

21666 (ORNL-tr-2826) ALTERNATI TORSION OF AUSTENITIC STAINLESS STEELS AT ELEVATED TEMPERATURES. Part I. Mechanical Response. Fuentes, M. Translated by R. G. Mansfield from Rev. Met. (Madrid); 8: No. 2, 91-97(1972). 10p. Dep. NTIS $4.00.

Two stainless steels—18% Cr–10% Ni and 25% Cr–20% Ni—in the initial annealed state were deformed by alternating torsion until the saturation stress (τ) was reached, over a wide range of temperature (T), from 400 to 1000°C and plastic deformation per cycle ($\Delta\gamma_P$) of 1% to 6%, with a deformation rate ($\Delta\dot{\gamma}_P$) of 10^{-3}–10^{-4} sec^{-1}. Analysis of the effect of temperature, amplitude of torsion (θ), and frequency (rpm) in the response of these materials to the alternating torsion test is discussed. (auth)

21667 (ORNL-tr-2833) INFLUENCE OF GRAIN BOUNDARIES ON DEFORMATION AND FRACTURE OF METALLIC MATERIALS AT HIGH TEMPERATURE. I. Deformation. Ohta, S. Translated by H. Kubota from Zairyo; 23: No. 246, 167-173(1974). Dep. NTIS $4.00.

The effects of crystal grain boundaries on deformations at high temperature due to creep and superplastic behavior were examined. It was found that the crystal grain boundary exerts large influence on high temperature deformation, particularly high temperature and low stress deformation, mainly through grain boundary slip. At the same time, grain boundary slip is important in that it has a controlling effect on high temperature fracture. There are still many uncertain areas in the elucidation of grain boundary slip, however, it is expected that future studies involving direct observation of grain boundary dislocations will make clear the mechanism of grain boundary slip itself as well as the mechanisms that contribute to deformation and fracture. (JRD)

21668 (RDT-M-2-19-T(5-74)) 2¼-PERCENT-CHROMIUM, 1-PERCENT-MOLYBDENUM ALLOY STEEL TUBESHEET FORGINGS (ASME SA-336 WITH ADDITIONAL REQUIREMENTS). (USAEC Division of Reactor Research and Development, Washington, D.C.). May 1974. 9p. RSO.

A standard prescribing requirement for 2¼% Cr–1% Mo alloy steel tube sheet forgings (ASME SA-336 with additional requirements) for nuclear and associated applications is presented. (JRD)

21669 (RFP-2067) EFFECT OF INOCULATION OF URANIUM AND URANIUM–6 WT % NIOBIUM WITH 0.01 TO 1.0 WT % TITANIUM ON IMPURITY LEVELS. Avery, J. G. (Dow Chemical Co., Denver, Colo. (USA). Rocky Flats Div.). 5 Jul 1974. Contract AT(29-1)-1106. 8p. Dep. NTIS $4.00.

Titanium in the range 0.01 to 1.0 wt % was added to uranium and uranium–6 wt % niobium. Some titanium additions were made during arc melting followed by induction remelting; other titanium additions were made directly to the induction melt. Chemical analyses and metallographic examination determined that significant cleaning of the impurities carbon and nitrogen occurs in uranium with titanium additions above 0.5 wt %. When the added titanium level is on the order of the impurities present, no significant removal of carbon, nitrogen, or oxygen occurs. In uranium–6 wt % niobium alloy, no level of titanium addition examined resulted in a significant reduction in carbon, nitrogen, or oxygen levels. (auth)

21670 (TID-26595) OUTGASSING CHARACTERISTICS OF METALS AND ALLOYS. Final Report, February 16, 1971–February 15, 1972. Himmel, L. (Wayne State Univ., Detroit, Mich. (USA)). 1972. Contract AT(11-1)-2120. 10p. Dep. NTIS $4.00.

An ultra-high vacuum system, specially designed for studying the outgassing characteristics of metals and alloys at high temperatures has been used to investigate the kinetics of desorption of nitrogen from Mo–C alloys. It has been found that the presence of carbon in molybdenum in amounts exceeding the solubility limit gives rise to anomalously low values of the diffusion coefficient for nitrogen, as well as to a high apparent activation energy for nitrogen diffusion. Carbon in the form of second phase carbides, therefore, acts as a trap for interstitial nitrogen. The kinetics of internal nitriding of Mo–Hf and Mo–Zr alloys have been determined at temperatures between 1200 and 1500°C. The permeation rate of nitrogen in Mo derived from the diffusion–controlled nitriding kinetics is found to be in good agreement with steady–state permeation data. Preliminary evidence has been obtained which indicates that HfN and ZrN dispersions in Mo coarsen at a greater rate in vacuum than in a nitrogen atmosphere, in accord with thermodynamic considerations. (auth)

21671 (UCID-16491) ALGORITHMS FOR REDUCING YTTERBIUM. Hearst, J. R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 22 May 1974. Contract W-7405-eng-48. 15p. Dep. NTIS $4.00.

Computer-compatible algorithms for obtaining stress-time histories from the voltage-time histories of dual-conductor ytterbium gages have been developed from the data of M. J. Ginsberg of the Stanford Research Institute. The technique is used to divide both the loading and unloading behavior of the ytterbium into several regions and to fit curves suggested by Ginsberg's work to each region. (auth)

21672 (UCRL-51544) FRACTURE TOUGHNESS OF THIN BERYLLIUM SHEET. Tardiff, G. E. Jr. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 28 Feb 1974. Contract W-7405-eng-48. 154p. Dep. NTIS $5.45.

Thesis. Submitted to Michigan Technological Univ., Houghton.

The ambient-temperature fracture toughness of thin beryllium sheet (0.80 mm thick) was measured for a wide variety of metallurgical conditions. Various experiments were also carried out to develop an understanding of the factors that account for and limit the magnitude of the fracture toughness. In order to measure the fracture toughness over the widest possible range in yield-strength and fracture-toughness levels, it was necessary to develop fracture test methods for the large-scale plastic yielding regime. Three independent methods, one developed previously by others (J integral) and two new methods (based on a compliance technique and a plastic work approach), were found to give equivalent results. The fracture toughness of the ingot source sheet under investigation varied depending on the effect of heat treatment on the microstructure. The low toughnesses were associated with the presence of small subgrains in the microstructure. It was concluded that these small subgrains enabled the bend-plane splitting mechanism to reduce the toughness. A study of the effect of crack root diameter on the fracture toughness supports the conclusion that, in material containing subgrains, the conditions that govern yielding in the grains immediately adjacent to the crack tip control the magnitude of the fracture toughness. The high toughness conditions of the ingot sheet were associated with complete recrystallization and the absence of subgrains in the microstructure. The magnitude of the toughness in the latter case was accounted for in terms of a plane-stress fracture model based upon the Dugdale analysis, and the flow strength and capacity for through-thickness contraction measured in the tensile test. The strains measured ahead of the crack tip were found to be consistent with the plane-stress model and the assumption that the ability to contract through the thickness determines the magnitude of the fracture toughness. The magnitude of the fracture toughness determined for powder-origin beryllium sheet was also accounted for in terms of the plane-stress model and the flow strength and through-thickness contraction measured in the tensile test. Lower toughnesses were observed for the powder sheet than for the tough condition of the ingot sheet. This difference was associated with a smaller capacity for through-thickness contraction in the case of the powder sheet because of its more pronounced preferred orientation. (auth)

21673 (UCRL-51575) MODIFICATION OF THE GRAY EQUATION OF STATE IN THE LIQUID-VAPOR REGION. Young, D. A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Apr 1974. Contract W-7405-eng-48. 32p. Dep. NTIS $4.00.

A modification of the GRAY three-phase equation of state is described. This modification permits accurate calculation of the pressure in the mixed phase liquid-vapor region. A listing of the computer code modification is given along with a listing of two-phase region parameters for sixteen metals. Plots of the modified equation of state are also presented. (auth)

21674 INFLUENCE OF RELATIVE HUMIDITY ON FLOW OF METAL AND CERAMIC POWDERS. Matel, G. (Polytechnic Inst., Cluj); Claussen, N.; Hausner, H. H. pp 5-11 of Modern Developments in Powder Metallurgy. Vol. 7. Hausner, H. H. (ed.). Princeton, NJ; Metal Powder Industries Federation (1974).

From 4th international conference on powder metallurgy; Toronto, Canada (15 Jul 1973). See CONF-730718-P8.

Results of tests on the flowability of Cu, W, and Al_2O_3 powders show that in the usual humidity ranges, i.e., between 30 and 70% relative humidity the flow time curves exhibit various reproducible minima and maxima which are, however, apart by less than 3% of the mean flow time. In atmospheres below 30% the powder flows faster with decreasing relative humidity. The influence of temperature variations in flow time is only considerable when ceramic powders are involved. (auth)

21675 PREDICTION OF PROCESSING PROPERTIES OF METAL POWDERS. McMahon, D. J. (Allegheny Ludlum Indus-

tries, Inc., Brackenridge, PA); Reen, O. W. pp 41-60 of Modern Developments in Powder Metallurgy. Vol. 7. Hausner, H. H. (ed.). Princeton, NJ; Metal Powder Industries Federation (1974).

From 4th international conference on powder metallurgy; Toronto, Canada (15 Jul 1973). See CONF-730718-P8.

With the aid of statistically designed experiments and computer techniques, a method for predicting the processing characteristics of metal powders has been proposed and verified by an application using stainless steel powder. Using this procedure, models may be applied in simulating the processing characteristics before a purchase is made. Hence, it may be used as an effective screening mechanism for improved product reliability. It should be noted that other variables, e.g., carbon and silicon contents, various lubricants, sintering atmospheres and times, may be added to the developed response equations. This is done by augmenting the first generated data with more data from another statistically designed experiment. Thus, through an evolutionary experimental process, more complex models may be developed which represent unique applications. (auth)

21676 HIGH STRENGTH AS SINTERED P/M STEELS. Fischer, J. J. (International Nickel Co., Inc., Sterling Forest, NY). pp 75-84 of Modern Developments in Powder Metallurgy. Vol. 7. Hausner, H. H. (ed.). Princeton, NJ; Metal Powder Industries Federation (1974).

From 4th international conference on powder metallurgy; Toronto, Canada (15 Jul 1973). See CONF-730718-P8.

The effects of additions of Ni, Mn, and Mo on the strength and ductility of a powder metallurgy steel prepared from mixed elemental powders and sintered at 2050°F were examined. The results show that high strength levels can be achieved without heat treating in certain P/M steels containing nickel, manganese, and molybdenum. Specifically, at the 2% Ni level, a composition of Fe-2Ni-(0.5 Mn to 1.0)Mn-1Mo-0.4C produces the highest tensile strength (over 80,000 psi) with a yield strength of about 50,000 psi for a sintered density of 6.9 to 7.0 g/cm^3. At the 4% Ni level, a yield strength exceeding 60,000 psi and tensile strength over 100,000 psi were obtained after sintering for ½ hour at 2050°F. The results also show that by extending the sintering time to 50 minutes at 2050°F a yield strength of 75,000 psi and a tensile strength of 118,000 psi can be obtained. All of the specimens examined showed excellent dimensional stability in that a linear expansion of 0.3%, or less, occurs as a result of sintering. Examination of the microstructure combined with x-ray diffraction analyses indicated the presence of a substantial amount of bainite and martensite, in addition to pearlite and primary ferrite. The amount of martensite present increased with increasing nickel content. It is believed that the formation of these phases upon cooling from the sintering treatment is responsible for the high strength levels obtained. (auth)

21677 EFFECT OF DENSITY ON THE PROPERTIES OF PREALLOYED Ni-Mo LOW ALLOY STEEL POWDERS. Holcomb, R. T.; Lovenduski, J. (Hoeganaes Corporation, Rivertown, NJ). pp 85-107 of Modern Developments in Powder Metallurgy. Vol. 7. Hausner, H. H. (ed.). Princeton, NJ; Metal Powder Industries Federation (1974).

From 4th international conference on powder metallurgy; Toronto, Canada (15 Jul 1973). See CONF-730718-P8.

The sintered and heat treated mechanical properties of premixes and prealloys at 0.5 Ni-0.6 Mo and 1.8 Ni-0.5 Mo compositions were examined. Results show that prealloyed iron-nickel-molybdenum powders yield stronger materials of greater hardenability than premixed elemental powders at the same composition and density. Differences in ductility between the materials in the sintered condition at high strength levels are negligible. The utility of premixed alloys is shown when comparison is made on an equal compacting pressure basic at constant composition. Then the superior compressibility of a premix is sufficient to overcome its comparative strength deficiency and significantly greater ductilities are obtained than can be realized with prealloyed powders. (JRD)

21678 DEVELOPMENT OF SUPERIOR FERROUS ALLOYS. Terchek, R. L.; Hirschhorn, J. S. (Central Research Labs., St. Paul, MN). pp 109-133 of Modern Developments in Powder Metallurgy. Vol. 7. Hausner, H. H. (ed.). Princeton, NJ; Metal Powder Industries Federation (1974).

From 4th international conference on powder metallurgy; Toronto, Canada (15 Jul 1973). See CONF-730718-P8.

A low alloy, age hardening porous steel has been evaluated. The alloy is age hardenable in either the martensitic or salt bath transformed condition. The low quench sensitivity of the alloy could permit hardening by simply cooling from the sintering temperature to a zone maintained at 1000°F in a continuous furnace. A similar procedure might be employed to simplify heat treatment of powder preforms. Tensile specimens in which ferrite is dispersed in the low nickel regions of a tempered or age hardened martensitic matrix exhibit higher elongation than do otherwise equivalent single phase martensitic specimens. A loss in yield and ultimate strengths accompanies the improved ductility, but the combination of properties is unique and cannot be obtained by conventional quenching and tempering or aging. It is suggested that failure in conventional fully martensitic steels is nucleated in the low nickel martensite. Research to improve properties of such steels should, therefore, begin with modification of such regions. Nickel gradients, which strongly influence age hardening, tempering, and transformation characteristics were found, in part, to result from particle agglomeration by application of the concentric sphere diffusion model. An appreciation of the effects of nickel inhomogeneity is required to effectively continue development of improved sintered nickel steels. (auth)

21679 STRENGTHENING OF LIQUID SINTERED TUNGSTEN ALLOYS. Dickinson, J. M.; Riley, R. E.; Taub, J. M. (Los Alamos Scientific Lab., NM). pp 329-352 of Modern Developments in Powder Metallurgy. Vol. 7. Hausner, H. H. (ed.). Princeton, NJ; Metal Powder Industries Federation (1974).

From 4th international conference on powder metallurgy; Toronto, Canada (15 Jul 1973). See CONF-730718-P8.

A large number of W base liquid phase alloys have been made and studied. The high strength values, high densities and high modulus values desired were obtained. Although the ductilities were generally good in compression, brittle failure was the rule in tension. Rhenium in particular had a strong strengthening effect. The high hardness and brittleness of the high Re content alloys can be explained by the sigma phase present in the matrix. While alloy matrix W alloys show promise, difficulty in obtaining small sizes of alloy powders having a good particle size distribution has been a serious drawback. Tungsten alloys made with Co-Ni plated W have good properties if sintering conditions are controlled. (auth)

21680 HETEROGENEOUS TRACE IMPURITIES OF RAW MATERIALS IN P/M REFRACTORY METALS. Lassner, E.; Benesovky, F. (Metallwerk Plansee, Reutte, Austria). pp 353-370 of Modern Developments in Powder Metallurgy. Vol. 7. Hausner, H. H. (ed.). Princeton, NJ; Metal Powder Industries Federation (1974).

From 4th international conference on powder metallurgy; Toronto, Canada (15 Jul 1973). See CONF-730718-P8.

The effects of heterogeneous impurities on defects in sintered and worked refractory metal products were studied. It was found that heterogeneous impurities have far more severe consequences in powder metallurgy than in fusion metallurgy. Whereas heterogeneous impurities are rapidly distributed homogeneously in a melt, or are eliminated via the slag, the distribution during sintering is very slow and a complete elimination is impossible. Hence, with the current high demands on the properties of sintered materials, increasing attention must be given to the corresponding raw material specifications, taking into account the information provided by modern microscopic and analytical methods. (auth)

21681 EFFECT OF STRUCTURE ON THE LOW TEMPERATURE PROPERTIES OF P/M Rene 80. Fox, H. M. (General Electric Co., Schenectady, NY). pp 491-518 of Modern Developments in Powder Metallurgy. Vol. 7. Hausner, H. H. (ed.). Princeton, NJ; Metal Powder Industries Federation (1974).

From 4th international conference on powder metallurgy; Toronto, Canada (15 Jul 1973). See CONF-730718-P8.

The low temperature (≤1300°F) tensile/rupture properties of P/M René 80, a γ' age-hardenable nickel-based superalloy, have been studied in relation to the structure. Three René 80 powder sizes (-80, +100; -80, +270; and -230, +325 mesh), classified from the same master powder lot, were hot isostatically pressed (HIP) at 2300°F/500 or 750 psi/1 h. After compaction, the -80, +270 mesh powder was also deformed up to 15% reduction. Quantitative metallographic analyses and electron microscopy have been used to characterize the structure, i.e. the grain size and γ' morphology. It was found that the Hall-Petch (grain size) and γ' strengthening are responsible for the room temperature flow stress (0.2% YS). However, the YS does not appear to be controlled by the larger γ' particles (~0.5 μ). Relatively little deformation dramatically increases (30% at 15% reduction) tensile strength without ductility loss. However, to achieve an increase in rupture life, the material must be accorded a solution (+ age) heat treatment so that the substructure is optimized. The UTS (or fracture strength) and ductility is independent of the flow stress. Ductility, which is controlled by carbides on prior particle boundaries and/or continuous γ' + carbide films determine the UTS. Grain size refinement can offset embrittlement. The loss of Hall-Petch strengthening at elevated temperature decreases as the grain size is increased or as substructure is introduced. (auth)

21682 P/M HIGH SPEED STEELS MODIFIED BY ADDITION OF MONOCARBIDES. Kieffer, A. R.; Ettmayer, P.; Jangg, G.; Weissmann, G. (Technical Univ., Vienna). pp 519-536 of Modern

Developments in Powder Metallurgy. Vol. 7. Hausner, H. H. (ed.). Princeton, NJ; Metal Powder Industries Federation (1974).

From 4th international conference on powder metallurgy; Toronto, Canada (15 Jul 1973). See CONF-730718-P8.

P/M high speed steels (HSS) have to compete against melted and cast HSS. Even if it is possible to reduce reject rates as compared with conventional high speed steels and even if they exhibit a significantly superior cutting performance and tool life, it remains still doubtful, whether they can be made attractive commercially. By addition of monocarbide powder to the HSS powder, however, the manufacturing costs should not be increased very much, but there is a very marked gain in tool life time or an increased cutting speed. On the other hand the carbide modified HSS are still heat treatable, a fact, which should be considered, when grinding costs are brought up against cemented carbide tools. Carbide modified high speed steels can be manufactured by normal sintering with liquid phase. This reduces some of the problems, which are cropping up with hot isostatic compaction. Standard equipment such as that used in cemented carbide production can be utilized. Hot coining or hot forging lead to very near 100% density. Of the transition metal monocarbides only TiC, VC and as solid solutions furthermore Mo_2C and WC proved to be beneficial to the mechanical properties of sintered HSS. Especially $TiC-Mo_2C$ and $TiC-VC-Mo_2C$ solid solutions are suitable additives. They improve the sintering characteristics and lead to an increased resistance against temper softening. It is felt that P/M will initiate a new development in the field of high speed steels, especially in the direction of carbide modified HSS. (auth)

21683 POWDER METALLURGY IN-100-PROCESSING, MICROSTRUCTURE AND MECHANICAL PROPERTIES. Larson, J. M. (International Nickel Co., Inc., Sterling Forest, NY). pp 537-566 of Modern Developments in Powder Metallurgy. Vol. 7. Hausner, H. H. (ed.). Princeton, NJ; Metal Powder Industries Federation (1974).

From 4th international conference on powder metallurgy; Toronto, Canada (15 Jul 1973). See CONF-730718-P8.

Excellent creep, stress-rupture, and tensile properties of interest for turbine disk applications have been obtained on P/M In-100 produced from the same master melt by argon atomization, vacuum atomization, and the rotating electrode process. The mechanical properties of the P/M material were superior to those of the as-cast and cast and wrought materials. Grain growth at elevated temperatures in P/M IN-100 is inhibited primarily by a semicontinuous TiC network which forms on prior powder particle boundaries (PPB). Below the γ' solvus large gamma prime particles also inhibit grain growth. In contrast to the other atomization techniques, the rotating electrode process (REP) conditions do not decompose large TiC particles; therefore, in powder of equal total carbon content, smaller amounts of carbon are available in REP material for the formation of TiC films on PPB. This results in less TiC at PPB in the REP powder and grain growth is more rapid in REP material than in the material made by other atomization techniques. The thickness of the carbide-containing film at the prior particle boundaries of P/M IN-100 increases with increasing oxygen and nitrogen contents. P/M IN-100 ductility decreases with increasing thickness of the Ti-rich oxy-carbo-nitride film. Mechanical properties are not affected by exposure of the powder to air as long as appropriate precautions are taken in canning. (auth)

21684 MECHANICAL PROPERTIES AND STRUCTURAL CHARACTERISTICS OF UNITEMP C-300. Schwertz, J. H.; Lherbier, L. W. (Cyclops Corp., Bridgeville, PA). pp 567-586 of Modern Developments in Powder Metallurgy. Vol. 7. Hausner, H. H. (ed.). Princeton, NJ; Metal Powder Industries Federation (1974).

From 4th international conference on powder metallurgy; Toronto, Canada (15 Jul 1973). See CONF-730718-P8.

Under NASA sponsorship, Universal-Cyclops Specialty Steel Division has developed an experimental nickel-base superalloy designated "Unitemp C-300." Investigations with cast and extruded material of this composition have shown very promising strength capabilities. The alloy was designed for optimum properties in the 1200°F range of engine performance. However, results of studies have indicated that the alloy responds favorably to full solution heat treatment and improved properties at higher temperatures. In-house research on the cast and extruded material involving variations in thermomechanical processing has resulted in the optimization of these processing variables to give the most desirable combination of mechanical properties and structural characteristics. A direct comparison of vacuum melted, argon atomized, hot pressed, and extruded Unitemp C-300 is made with as-cast and extruded material, with respect to mechanical properties and structural characteristics, utilizing the optimum thermomechanical processing variables previously established. Comparisons are also made with published mechanical properties of existing high temperature alloys in their temperature range of operation. These studies have (1) established the exceptional versatility of this alloy for both high and low temperature applications, (2) shown strength characteristics of the alloy to significantly exceed those of the best currently available alloys on the market today, (3) indicated the advantages of a powder metallurgy manufacturing approach versus a conventional approach to this alloy system in terms of equal or better mechanical properties, increased yields, better homogeneity, and overall better workability, and (4) demonstrated the advantage of additional hot work on the mechanical properties of both wrought and powder metallurgy material. (auth)

21685 EFFECT OF UNIFORM PRESSURE AND ALLOYING ON THE FORMATION OF ω PHASE IN TITANIUM- AND ZIRCONIUM-BASED ALLOYS. Kirshenina, I. I.; Fedotov, L. N. pp 76-77 of Splavy Redkikh Metallov s Osobymi Fizicheskimi Svoistvami. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian)

On the basis of a consideration of the different atomic volume of the α and β phases and of the change of the lattice parameters of the β phase during alloying, the effective internal pressure necessary for the formation of ω phase in Ti and Zr alloys was calculated. The calculation results were compared with experimental data. (tr-auth)

21686 STUDY AND DEVELOPMENT OF SAMARIUM-COBALT PERMANENT MAGNETS. Savitskii, E. M.; Medvedev, B. V.; Terekhova, V. F.; Tsirkov, A. I.; Torchinova, R. S.; Gladyshev, S. N.; Kolokol'nikova, T. M. pp 92-96 of Splavy Redkikh Metallov s Osobymi Fizicheskimi Svoistvami. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian)

Physicochemical properties of the chemical compound $SmCo_5$ and data on the fabrication of permanent magnets from powders of this compound are reported. A magnet with the properties of ${}_BH_c = 5280$ Oe, ${}_IH_c = 10,450$ Oe, $B_r = 7220$ G, and $(BH)_{max} = 11.2 \times 10^6$ G · Oe was prepared. A processing scheme for fabricating magnets with these properties was given. (tr-auth)

21687 EFFECT OF ALLOYING WITH LESS COMMON AND RARE EARTH METALS ON THE ELECTRICAL AND MAGNETIC PROPERTIES OF INVAR Fe-Ni ALLOYS. Kirshenina, I. I.; Smirnova, G. P.; Fedotov, L. N. pp 96-100 of Splavy Redkikh Metallov s Osobymi Fizicheskimi Svoistvami. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian)

The magnetization intensity and electrical resistance in the region of hydrostatic pressures up to 15 kbar and the high-frequency surface resistance in the decimeter wavelength region were studied for Fe-36% Ni alloys alloyed with the d-metals Sc, Ti, V, and Re and with the 4 f-metals Ce, Sm, Eu, Gd, and Dy. The magnetization intensity of all alloys is decreased and the electrical resistance is increased with pressure with the exception of alloys with Ce and Sm. The relative change of the magnetic intensity with pressure is greater in those alloys in which the relative change of the resistance with pressure is less. During uhf measurements, ferromagnetic resonance with a line width of $\Delta H = 120$ to 200 Oe was observed. The change of the alloy structure after pressures up to 15 kbar was studied. (tr-auth)

21688 ABNORMAL ABSORPTION AND VELOCITY OF SOUND IN MONOCYSTALS OF DYSPROSIUM-GADOLINIUM ALLOY. Goncharov, K. V.; Mal'tseva, I. V.; Savitskii, E. M.; Chistyakov, O. D. pp 107-109 of Splavy Redkikh Metallov s Osobymi Fizicheskimi Svoistvami. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian)

An abnormal velocity and attenuation of sound close to the Curie point was observed in 50-50% Dy-Gd alloys. The unusally large amplitude of anomalies in the alloy in comparison with the pure metals and the experimental exponents b and c of the temperature dependence of the anomalies $\Delta\alpha \sim (T - T_c)^{-b} \approx (T - T_c)^{-0.8\pm0.15}$ and $\Delta\alpha \sim (T - T_c)^{-c} \approx (T - T_c)^{-0.2\pm0.03}$ are discussed. (tr-auth)

21689 EFFECT OF LESS COMMON METALS ON THE ACOUSTICAL PROPERTIES OF MAGNESIUM. Drits, M. E.; Rokhlin, L. L. pp 109-113 of Splavy Redkikh Metallov s Osobymi Fizicheskimi Svoistvami. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian)

Because of their low level of attenuation of ultrasonic oscillations, Mg alloys are used as materials for ultrasonic delay lines. Especially low damping of the ultrasonics are obtained in alloys of Mg with the rare earth metals Ce and Nd. The Mg-Ce and Mg-Nd systems were used for the development of Mg alloys for the acoustical lines MA17 (MD3-1) and MD3-2. Supplementary alloys of these alloys with Zn, Cd, and Ba affects only slightly the damping coefficient. Introduction of Al and Sn in quantities up to 4 wt % leads to a significant increase of the damping coefficient of the alloys of Mg with the rare earth metals. The ultrasonic damping coefficient depends on the structural state of the alloy.

The lowest value of the damping coefficient was attained after processing which ensured small recrystallized grains. The variation of the velocity of ultrasonics during alloying of Mg with rare earth metals takes place to an insignificant degree. The low damping coefficient for ultrasonics of alloys of Mg with Ce and Nd is connected with the crushing of the grain during addition of these elements, reduction of the melt, and immobilization of the dislocations. (tr-auth)

21690 CALCULATION OF THE ELECTRICAL PROPERTIES OF ALLOYS. Savitskii, E. M.; Burov, I. V.; Pirogova, S. V. pp 152-156 of Splavy Redkikh Metallov s Osobymi Fizicheskimi Svoistvami. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian)

The effect of alloying, temperature, dislocations, and vacancies on the electrical properties of alloys was examined. A quantitative evaluation was made of the contribution of dislocations and vacancies to the electrical resistance of Mo monocrystals at 4.2°K. The electrical conductivity of W–Mo, W–Nb, W–Ta, and Mo–Nb was calculated. A calculation method was developed for the numerical evaluation of the value of the electrical conductivity of solid solution based on metals with cubic lattices. (tr-auth)

21691 CHARACTERISTICS OF THE ELECTRICAL RESISTANCE OF TITANIUM, ZIRCONIUM, AND HAFNIUM. Bykov, V. N.; Rudnev, I. I.; Solov'ev, V. A. pp 156-158 of Splavy Redkikh Metallov s Osobymi Fizicheskimi Svoistvami. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian)

The electrical resistance of Ti, Zr, and Hf was measured in the temperature interval from 0 to 1200°C. The results of the calculation of the temperature dependence of the electric resistance of these metals, made by use of the two-zone model in conjunction with the values of the Hall constants, indicated that the conductivity takes place by carriers of both signs. (tr-auth)

21692 MECHANICAL PROPERTIES OF MOLYBDENUM–RHENIUM–CARBON ALLOYS. Savitskii, E. M.; Tylkina, M. A.; Fridman, Z. G.; Ermishkin, V. A.; Konieva, L. Z. pp 161-163 of Splavy Redkikh Metallov s Osobymi Fizicheskimi Svoistvami. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian)

The mechanical properties of the Mo–Re–C alloys MR-47VP and Mo–45 Re–0.12 C (deformed and annealed states) were studied at room temperature and higher temperatures. It was established that the alloy Mo–45 Re–0.12 C has a very high stability property in the temperature interval from 600 to 1000°C and is slightly inferior to the MR-47VP alloy in ductility in this same temperature interval. At temperatures above 1200°C noticeable differences in the properties were not observed either in the alloys with different states or in the alloys with different composition. The ductility of the MR-47VP alloy in the temperature range above 800°C is larger than the ductility of the other alloy. In creep studies at 1100°C, the Mo–45 Re–0.12 C alloy showed a higher resistance to creep than the other alloy at all intervals studied of the creep rate. (tr-auth)

21693 ELASTIC AND MECHANICAL PROPERTIES OF ALLOYS OF THE Mo–B SYSTEM. Kharitonov, V. I.; Fedotov, S. G.; Makunin, M. S.; Shamrai, F. I.; Falaleeva, Z. S.; Sinodova, E. P. pp 163-166 of Splavy Redkikh Metallov s Osobymi Fizicheskimi Svoistvami. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian)

Two series of Mo–B alloys with B concentrations up to 0.04% were smelted by the electron beam fusion method. The first series of alloys contained 0.003% C and the second 0.01%. The elastic constants of the alloys were studied by the resonance method. Minima on the curves of the variation of the elastic constant obeyed the limitations of the solubility of β-rhombohedral B in Mo. Additional growth of the elastic properties coincided with the formation of surplus phases in the alloy. The solubility of B in Mo containing 0.003% C is about 0.02 at 2000° but 0.005% at 900, 800, and 600°. The solubility of B in Mo containing 0.01% C is ~0.012 at 2000° and is less than 0.005% at 1000°. The mechanical properties of deformed Mo–B alloys were studied at room temperature. From an analysis of the elastic and mechanical properties, optimum limits for the alloying of Mo with B were determined from the viewpoint of ductility. These were 0.002 to 0.005% B at 0.01% C and 0.005 to 0.1% B at 0.003% C. (tr-auth)

21694 THERMOELECTRIC PROPERTIES OF ALLOYS OF VANADIUM ALLOYED WITH ELEMENTS OF THE IV–V GROUP. Druzhinina, I. P.; Vladimirskaya, T. M.; Fraktovnikova, A. A.; Gushchin, G. I. pp 166-170 of Splavy Redkikh Metallov s Osobymi Fizicheskimi Svoistvami. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian)

The thermo emf of binary alloys of V alloyed with 1 to 30 wt % Ti, 0.5 to 16 wt % Zr, 0.5 to 8 wt % Hf, 0.5 to 60 wt % Nb, or 0.5 to 20 wt % Ta was measured on thermocouples with Pt at temperatures from 0 to 1500°C. The electrical resistance of the alloys was also measured. The coefficients A, B, and C of second order equations, approximating the change of the thermo emf in the interval from 300 to 1300°C were calculated. (tr-auth)

21695 THERMOELECTRIC PROPERTIES OF REFRACTORY METALS. Druzhinina, I. P.; Fraktovnikova, A. A.; Vladimirskaya, T. M.; Gushchin, G. I. pp 170-174 of Splavy Redkikh Metallov s Osobymi Fizicheskimi Svoistvami. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian)

The thermo emf, thermoelectric inhomogeneity, and the reproducibility of the calibration curve were determined for W, Mo, Re, Ta, Nb, V, Ti, and Hf. The electric resistance of these metals was also measured. The thermo emf was measured with Pt thermocouples at temperatures from 0 to 1500°C and in V with Mo thermocouples also from 1100 to 1600°C. The A, B, and C coefficients of the second order equation approximating the change of the thermo emf of these metals in the interval from 300 to 1300°C were calculated. (tr-auth)

21696 STRUCTURE AND PROPERTIES OF SOME ALLOYS OF TUNGSTEN WITH NIOBIUM, TANTALUM, RHENIUM, AND CARBON. Savitskii, E. M.; Povarova, K. B.; Makarov, P. V. pp 174-181 of Splavy Redkikh Metallov s Osobymi Fizicheskimi Svoistvami. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian)

The structure, deformability, coefficient of linear thermal expansion, temperature of the initiation of recrystallization, alloying effect, and annealing temperature in solid alloys of W were studied at room and higher temperatures. Alloys maintaining their hardness at temperatures up to 1000° (200 to 250 kg/mm^2) were prepared. The temperatures for the initiation of recrystallization was between 1550 and 1900°C. A small grain was maintained after recrystallizing annealing at 1700 to 1900°C. (tr-auth)

21697 SECONDARY ELECTRON EMISSION OF METALS AND ALLOYS. Gomoyunova, M. V. pp 185-192 of Splavy Redkikh Metallov s Osobymi Fizicheskimi Svoistvami. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian)

The basic laws of the phenomenon of secondary electron emission in metals and alloys are described. In polycrystalline metals, the secondary electron emission is uniquely connected with the atomic number of the element. For monocrystalline samples, it appears to be a structure-sensitive characteristic of the solid and is different in different grains of the crystal. Alloys were studied only in the polycrystalline form. It was observed that the emission of fast reflected electrons obeyed the principle of additivity. In contrast, the emission of slow truly secondary electrons under given conditions can be larger than in the individual components of the alloys. This is explained by the monoatomic adsorption of low-melting components of the alloy on its surface. The secondary electron emission of alloys depends on their thermal processing. (7 fig, 24 references) (tr-auth)

21698 PHYSICAL-CHEMICAL STUDY OF THE THERMOEMISSION PROPERTIES OF METALS AND ALLOYS. Savitskii, E. M.; Burov, I. V.; Litvak, L. N. pp 192-200 of Splavy Redkikh Metallov s Osobymi Fizicheskimi Svoistvami. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian)

Experimental data on the thermoemission properties of metals, alloys, and compounds in the polycrystalline and monocrystalline state were examined. The change of the work function of the elements, occurring in three large periods of the periodic system, was examined. The anisotropy of the work function of monocrystals of W, Mo, Nb, Ir, Ru, Mo–Nb, and Mo–Rh was studied. Work functions were determined for solid solutions in the systems Mo–Re, Ti–Hf, Re–Ru and Mo–Nb. On the basis of the present experimental results and results reported in the literature, laws were established for the change in the work function in the principal regions of the phase diagrams (solid solution, heterogenous mixture, and metallic compound). The correlation of the work function with other physical properties of the metals and alloys were established. (5 fig, 3 tables) (tr-auth)

21699 DYNAMICS OF THE EMISSION PROCESSES OF THE MOLYBDENUM–PLATINUM ALLOYS. Bakhtiyarov, R. S.; Bulgak, L. V.; Shishkin, B. B. pp 200-204 of Splavy Redkikh Metallov s Osobymi Fizicheskimi Svoistvami. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian)

The local emission parameters of Mo–Pt alloys were measured. The emission of cathodes is determined by the selective adsorption of individual grains and also depends on the relation of the diffusion rate and the desorption of elements of the alloy. The adsorption and migration processes of the low-melting components leads to the appearance of a hysteresis loop of the temperature dependence of the local work function of the crystals. The process of migration of Pt along the surface of the Mo–Pt alloy was observed directly for the first time. (tr-auth)

21700 EFFECT OF BORONIZING ON THE HARDENING OF REFRACTORY METAL-BASED ALLOYS. Burykina, A. L.;

Gubenko, B. G. pp 107-114 of Trenie i Iznashivanie Pri Vysokikh Temperaturakh. Khrushov, M. M. (ed.). Moscow; Izdatel'stvo Nauka (1973). (In Russian)

The efficiency of barrier shields on hardening at high temperature of Ta-, Nb-, and Mo-based alloys was shown using boride coatings as an example. A technology was developed for the deposition of the coatings. Their gaseous phases were studied and the optimum thickness was determined. The interaction of the alloys in the original state and after deposition of boride coatings was studied at temperatures up to 1500°C and loads up to 15 kg/mm^2 in high purity He atmosphere. (tr-auth)

21701 DIFFUSION OF HYDROGEN ISOTOPES INTO TANTALUM. Merisov, B. A.; Khadzhai, G. Ya.; Khotkevich, V. I. (Kharkov State Univ.). Fiz. Metal. Metalloved.; 37: No. 5, 1090-1092(May 1974). (In Russian).

The temperature dependence of the diffusion coefficients of hydrogen and deuterium into Ta was studied at 0 to 400°C. The method of obtaining the concentration profile based on the contactless measurement of the distribution of electrical resistance along the sample by the method of eddy currents was used for determination of the hydrogen and deuterium concentrations. Results are given graphically and the temperature dependence of the diffusion coefficient is tabulated. (JSR)

21702 CRYSTAL STRUCTURE AND MELTING POINT OF CALIFORNIUM METAL. Haire, R. G.; Baybarz, R. D. (Oak Ridge National Lab., TN). J. Inorg. Nucl. Chem.; 36: No. 6, 1295-1302(Jun 1974).

Thin films of californium metal were prepared by reducing Cf_2O_3 using lanthanum metal and condensing the volatile metal on electron microscopy grids. The metal deposits were then analyzed by electron diffraction. A fcc structure ($a_0 = 5.743 \pm 0.006$ Å) and a hexagonal close-packed structure ($a_0 = 3.988 \pm 0.004$ Å and $c_0 = 6.887 \pm 0.008$ Å) were observed in the initial californium deposits. The fcc structure changed to the hcp structure after the fcc deposits were heated in vacuum. The melting point of the metal was determined to be 900 ± 30°C by observing the metal deposits while they were heated in the electron microscope. The atomic radii calculated from the lattice parameters suggest that californium is divalent in the metallic state. (auth)

21703 EFFECT OF INTERSTITIAL (OXYGEN) AND SUBSTITUTIONAL (IRON) ELEMENTS ON STRAIN-AGING OF WEAKLY ALLOYED ZIRCONIUM AT DIFFERENT TEMPERATURES. de Paula e Silva, E.; Com-Nougue, J.; Beranger, G.; Lacombe, P. (Ecole Nationale Superieure des Mines, Paris). pp 269-290 of Relations Between Plastic Deformation and Phase Transformations. Saclay, France; Centre d'Etudes Nucleaires de Saclay ([nd]). (In French).

From 14th conference on metallurgy; Saclay, France (29 Jun 1971).

The strain aging of zirconium weakly alloyed with substitutional (Fe) or interstitial (O_2) elements leads to discontinuities in the tensile test curves. The influence of particular factors on age hardening was studied: duration and temperature of aging, oxygen contents, substitutional element contents, stresses under which the aging takes place, and the zirconium grain size. In the case of Kroll zirconium the phenomenon is maximum for a temperature of the order of 300°C. The discontinuity becomes less and less important as the purity of the material increases. The results suggest a blocking of the dislocations by interstitial elements (principally, oxygen). In contrast, when the oxygen content is high ($> 2700 \times 10^{-6}$), the discontinuity disappears. Results are discussed in terms of various dislocation blocking mechanisms such as those of Cottrell, Suzuki, and Snoek. An interpretation based on the existence of a Snoek phenomenon enables the results to be explained. (FR)

21704 HEAT OF FORMATION OF YTTRIUM-BISMUTH ALLOYS. Ferro, R. Borsese, A.; Capelli, R.; Delfino, S. (Univ., Genoa). Thermochim. Acta; 8: No. 4, 387-391(Apr 1974).

In the Y-Bi system the formation heats were measured using a direct isoperibol calorimeter. The following values were found for the two known compounds: YBi (solid state, 300°K), $\Delta H_{form} = -22.0 \pm 0.5$ kcal/g-at. Y_5Bi_3 (solid state, 300°K), $\Delta H_{form} = -19.5 \pm 0.5$ kcal/g-at. (auth)

21705 HEAT OF FORMATION OF NEODYMIUM-BISMUTH ALLOYS. Borsese, A.; Capelli, R.; Delfino, S.; Ferro, R. (Univ., Genoa). Thermochim. Acta; 8: No. 4, 393-397(Apr 1974).

The heats of formation of Nd-Bi alloys were measured using an isoperibol direct calorimeter. For the various compounds, the heats of formation (for the reaction among solid phases at 300°K) are (kcal/g-at.): Nd_3Bi, -15.0 ± 0.7; Nd_5Bi_3, -22.2 ± 0.7; Nd_4Bi_3, -25.0 ± 0.5; NdBi, -26.6 ± 0.5; $NdBi_2$, -21.0 ± 0.5. Results are briefly discussed. (auth)

21706 ELASTIC-PLASTIC POISSON'S RATIO OF BORSIC-ALUMINUM. Allred, R. E. (Sandia Labs., Albuquerque, NM); Hoover, W. R.; Horak, J. A. J. Compos. Mater.; 8: No. 1, 15-28 (Jan 1974).

Poisson's ratio as a function of tensile strain was examined for four volume fractions of unidirectional Borsic-reinforced aluminum composites. Linear relationships were found between Poisson's ratio and filament volume fraction during Stage I (elastic filaments-elastic matrix) and Stage II (elastic filaments-plastic matrix) deformation which could be correlated to filament and matrix values of Poisson's ratio. These results confirm that a simple rule-of-mixtures relationship may be used to predict composite Poisson's ratios as a function of filament volume fraction. The marked increase in the Poisson's ratio of the matrix upon yielding causes an abrupt rise in the slope of the composite Poisson's ratio versus longitudinal strain curve. This sudden increase may be used as an accurate method of determining matrix yield in filament-reinforced, metal-matrix composites. (9 figures) (auth)

21707 EFFECT OF CRACK LENGTH AND BOND STRENGTH ON THE DELAMINATION PROCESS IN BORSIC-Al COMPOSITES. Hoover, W. R.; Allred, R. E. (Sandia Labs., Albuquerque, NM). J. Compos. Mater.; 8: No. 1, 55-64(Jan 1974).

The effect of crack length and fiber-matrix bond strength on the delamination process in unidirectional Borsic-Al composites was examined using single-edge-notch specimens. The transverse tensile strength, σ_T, was used as an indirect measure of the fiber-matrix bond strength, which was altered through variations in hot pressing during composite fabrication. In composites with weak fiber-matrix bonds ($\sigma_T = 3.2$ ksi), the net-section stress at delamination, σ_D, was observed to decrease with increasing crack length. Variations in crack length did not significantly alter the basic fracture mechanism in which the delamination process led to notch insensitivity. Increases in the fiber-matrix bond strength (σ_T increased from 3.2 ksi to 13.2 ksi) caused a marked increase in σ_D but did not change the general delamination process. Through the use of cross-plied composites, the transverse strength was raised to 16.6 ksi and delamination was suppressed. This led to notch-sensitive fracture behavior and a substantial decrease in the fracture toughness compared to the composites which delaminated prior to failure. (auth)

21708 STUDY OF HYSTERESIS IN SOLID STATE TRANSITIONS OF THE RARE EARTH OXIDES. Lowe, A. T. Tempe, AZ; Arizona State Univ. (1974). 153p. University Microfilms Order No. 74-10,714.

Thesis (Ph. D.).

A thermogravimetric study of hysteresis in the TbO_x-O_2 system has provided insight into the phase transitions of the rare earth oxides. A series of isobaric scanning loops at 380 torr was made. The scans were between $TbO_{1.8}$ (φ) and $TbO_{1.714}$ (ν) at higher temperatures and between $TbO_{1.714}$ (ν) and $TbO_{1.818}$ (δ) at lower temperatures. It was found that the lower temperature loop was dependent upon the rate of heating and cooling with the exception that the δ' pseudophase within this loop was kinetically independent. The higher temperature loop was determined to be not kinetically controlled and this point was further verified by isobaric runs using single crystal TbO_x. The interior scanning loops made within the lower temperature hysteresis loop showed univariant behavior typical of a single phase when reversed in the δ' pseudophase region, otherwise, it exhibited bivariant behavior throughout the interior of the loop. Other scanning paths were made which rarely followed patterns previous theories would have predicted for hysteresis in solid state transitions. Some thermodynamic aspects and the microdomain concept as applied to hysteresis are considered. The effects of crystal size on hysteresis in phase reactions of praseodymium and terbium oxides were also studied by means of thermogravimetric analysis. A series of isobars were carried out at several different pressures and crystal sizes for the PrO_x-O_2 and TbO_x-O_2 systems. It was found that there were severe kinetic problems for reactions occurring at lower temperatures. At higher temperatures the amount of hysteresis decreased with increase in crystal size for both oxides and upon regrinding the larger crystals, the amount of hysteresis again increased. These experiments are contrasted with previous runs made with powder samples and some plausible explanations for the trends observed are discussed. Considering the two-phase regions to consist of microdomains of one phase in another, a theoretical model for these phase transitions was developed from the heterophase fluctuation theory. Taking the total free energy of the system to be a function of the chemical potential of both the phases, a surface free energy and the size and number of each domain, a distribution function was derived by minimizing the energy at a particular temperature and pressure. By calculating the change in microdomain size with change in the composition of the oxide, an estimate of the surface free energy and the range of microdomain sizes was determined. (Diss. Abstr. Int., B)

21709 PARTICLE DISTRIBUTION OF TUNGSTEN METAL POWDER BY TURBIDIMETRY. Philadelphia; American Society for Testing and Materials (1970). 4p. (ASTM-B-430-67).

This method covers the determination of particle size distribution of tungsten metal powder with a turbidimeter. The powder may be as-supplied, or after deagglomeration by rod milling. (DLC)

21710 MOLYBDENUM AND MOLYBDENUM ALLOY BAR, ROD, AND WIRE. Philadelphia; American Society for Testing and Materials (1974). 5p. (ASTM-B-387-74).

The unalloyed molybdenum are in arc-cast and powder-metallurgy form. The alloys are arc-cast Mo–0.5% Ti and arc-cast and powder-metallurgy TZM. The specification covers manufacture, chemistry, mechanical properties, softening temperature, permissible variations, etc. (DLC)

21711 NICKEL–IRON–CHROMIUM–MOLYBDENUM–COPPER ALLOY ROD AND BAR. Philadelphia; American Society for Testing and Materials (1972). 8p. (ASTM-B-425-72).

This specification covers the alloy in the form of hot-finished and cold-drawn rounds, squares, hexagons, and rectangles. The composition is 19.5 to 23.5% Cr, 38 to 46% Ni, 2.5 to 3.5% Mo, 1.5 to 3% Cu, and balance Fe. The specification covers chemical and mechanical property requirements, testing, permissible variations, straightness, special end uses, etc. (DLC)

21712 CHROMIUM–NICKEL–IRON–MOLYBDENUM–COPPER–COLUMBIUM STABILIZED ALLOY PLATE, SHEET, AND STRIP. Philadelphia; American Society for Testing and Materials (1973). 15p. (ASTM-B-463-73).

This specification covers soft Cr(19 to 21%)–Ni (32 to 38%)–Fe (balance)–Mo (2 to 3%)–Cu (3 to 4%)–Nb + Ta (up to 1%). Manufacture, finish, strip edges, chemistry, mechanical properties, testing, intergranular corrosion, permissible variations, etc., are covered. (DLC)

21713 NICKEL–MOLYBDENUM ALLOY PLATE AND SHEET. Philadelphia; American Society for Testing and Materials (1971). 6p. (ASTM-B-333-71).

This specification covers corrosion-resistant Ni–Mo alloy plate and sheet in the hot-rolled, annealed, and descaled condition. The composition is 4 to 6% Fe, 2.5% Co, 26 to 30% Mo, and balance Ni, with max 1% of other impurity elements. Purchase basis, manufacture, chemistry, sampling, testing, mechanical properties, grain size, permissible variations in dimensions, straightness, etc. are discussed. (DLC)

21714 NICKEL–MOLYBDENUM ALLOY ROD. Philadelphia; American Society for Testing and Materials (1971). 5p. (ASTM-B-335-71).

This specification covers corrosion-resistant Ni–Mo alloy rod in two conditions: hot-finished, annealed and descaled, 5/16 to 3/4 in. dia; and hot-finished, annealed, and ground or turned, 3/4 to 3 1/2 in. dia. The composition is 4 to 6% Fe, 2.5% Co, 26 to 30% Mo, and balance Ni, with max 1% of other impurity elements. Manufacture, chemistry, sampling, mechanical properties, testing, permissible variations in dimensions, straightness, etc. are covered. (DLC)

21715 NICKEL–CHROMIUM–MOLYBDENUM–IRON–COLUMBIUM SHEET AND PLATE. Philadelphia; American Society for Testing and Materials (1971). 7p. (ASTM-B-436-71).

This specification covers corrosion-resistant alloy sheet and plate in the annealed and descaled condition. The composition is 44 to 47% Ni, 21 to 23% Cr, 5.5 to 7.5% Mo, balance Fe, and 1.8 to 2.5% Nb + Ta. Manufacture, composition, mechanical properties, testing, dimensions and weights and permissible variations, sampling, etc. are covered. (DLC)

21716 TUNGSTEN BASE, HIGH DENSITY METAL. Philadelphia; American Society for Testing and Materials (1969). 6p. (ASTM-B-459-67).

This specification covers machinable, high-density tungsten base materials of four classes depending on tungsten content and three types depending on required minimum tensile properties. The materials are manufactured by powder metallurgy methods. The specification covers chemistry, physical requirements, quality assurance, etc. (DLC)

21717 UNALLOYED SINTERED TUNGSTEN BILLETS, BARS, RODS, AND PREFORMS FOR FORGING. Philadelphia; American Society for Testing and Materials (1968). 3p. (ASTM-B-410-68).

This specification covers shapes produced by powder metallurgical techniques for further processing by forging to semifinished products. Manufacture, chemical composition, mechanical and physical properties, quality, finish, inspection, etc. are covered. (DLC)

21718 NICKEL–IRON–CHROMIUM–MOLYBDENUM–COPPER ALLOY PLATE, SHEET, AND STRIP. Philadelphia; American Society for Testing and Materials (1972). 11p. (ASTM-B-424-72).

This specification covers rolled alloy plate, sheet, and strip. The composition is 38 to 46% Ni, balance Fe, 19.5 to 23.5% Cr, 2.5 to 3.5% Mo, and 1.5 to 3% Cu. Chemistry, mechanical properties, testing, permissible variations, dimensions, etc. are covered. (DLC)

21719 NICKEL–MOLYBDENUM–CHROMIUM–IRON ALLOY SHEET AND PLATE. Philadelphia; American Society for Testing and Materials (1971). 7p. (ASTM-B-434-71).

This specification covers corrosion-resistant Ni–Mo–Cr alloy plate and sheet in the annealed and descaled condition. The chemical composition is 15 to 18% Mo, 6 to 8% Cr, and 5% Fe. Chemical and physical requirements, permissible variations, sampling, testing, rejection, etc. are covered. (DLC)

21720 CADMIUM METAL. Philadelphia; American Society for Testing and Materials (1969). 3p. (ASTM-B-440-69).

This specification covers refined Cd metal recovered from ores and other materials. Chemical requirements, sampling for analysis, rejection, claims, etc. are covered. (DLC)

21721 NICKEL–CHROMIUM–MOLYBDENUM–COLUMBIUM ALLOY SEAMLESS PIPE AND TUBE. Philadelphia; American Society for Testing and Materials (1972). 7p. (ASTM-B-444-72).

This specification covers cold-drawn and hot-finished seamless pipe and tube intended for general corrosive service and heat-resisting applications. The composition is 20 to 23% Cr, 8 to 10% Mo, and 3.15 to 4.15% Nb + Ta. The specification covers chemistry, mechanical properties, testing, variations in dimensions and mass, etc. (DLC)

21722 NICKEL–CHROMIUM–IRON–COLUMBIUM–MOLYBDENUM–TUNGSTEN ALLOY SEAMLESS PIPE AND TUBE. Philadelphia; American Society for Testing and Materials (1972). 7p. (ASTM-B-445-72).

This specification covers Ni–Cr–Fe–Nb–Mo–W alloy cold-drawn and hot-finished seamless pipe and tube intended for general corrosive service and heat-resisting applications. The composition is 14 to 16% Cr, 5 to 9% Fe, and ≥8.75% Nb + Mo + W. The specification includes purchase basis, chemical requirements, mechanical properties, dimension variances, testing, special end uses, etc. (DLC)

21723 NICKEL–CHROMIUM–MOLYBDENUM–COLUMBIUM ALLOY ROD AND BAR. Philadelphia; American Society for Testing and Materials (1972). 7p. (ASTM-B-446-72).

This specification covers Ni–Cr–Mo–Nb alloy hot-finished rounds, squares and rectangles, and cold-drawn rounds. The composition is 20 to 23% Cr, 8 to 10% Mo, and 3.15 to 4.15% Nb + Ta. The specification covers purchase basis, chemical requirements, dimensions and tolerances, mechanical properties, testing, inspection, special end uses, etc. (DLC)

21724 NICKEL–CHROMIUM–MOLYBDENUM–IRON ALLOY SHEET AND PLATE. Philadelphia; American Society for Testing and Materials (1971). 6p. (ASTM-B-435-71).

This specification covers corrosion-resistant Ni–Mo–Cr–Fe alloy plate and sheet in the annealed and descaled condition. The composition is 8 to 10% Mo, 20.5 to 23% Cr, and 17 to 20% Fe. The specification covers properties, dimensions, sampling, testing, inspection, rejection, etc. (DLC)

21725 MAGNETIC, MOESSBAUER, STRUCTURAL, AND THERMAL STUDIES OF SOME $Ln_{1-x}Th_xFe_3$ INTERMETALLIC COMPOUNDS (Ln = Sc, Y, Ce, Pr, Gd, Dy, Lu). Kunesh, C. J. Pittsburgh; Univ. of Pittsburgh (1973). 156p. University Microfilms Order No. 74-8680.

Thesis (Ph.D.).

The pseudobinary system $Gd_{1-x}Th_xFe_3$ was previously found to exhibit anomalous magnetic behavior for $x \geq 0.5$ which could not be explained on the basis of the assumed magnetic structures of the parent compounds. An investigation was conducted to ascertain if these anomalies might extend to other $Ln_{1-x}Th_xFe_3$ systems and to gain more information about the nature of the anomalous magnetic state. The pseudobinary systems $Dy_{1-x}Th_xFe_3$, $Y_{1-x}Th_xFe_3$, $Lu_{1-x}Th_xFe_3$, $Sc_{1-x}Th_xFe_3$ and $Y_{0.1}Th_{0.9}Fe_{3-x}Al_x$ were synthesized. In addition to the compounds $Ce_{0.1}Th_{0.9}Fe_3$, $Pr_{0.1}Th_{0.9}Fe_3$ and $Y_{0.2}Th_{1.8}Fe_{17}$ were prepared. All materials were studied by powder x-ray diffraction and bulk magnetic measurements were performed from 4.2 to ~700°K. Moessbauer measurements were conducted on $Gd_{0.2}Th_{0.8}Fe_3$, $Y_{0.1}Th_{0.9}Fe_3$ and $Y_{0.1}Th_{0.9}Fe_{3-x}Al_x$, while low temperature (1.5 to 10°K) specific heats were determined for the $Y_{1-x}Th_xFe_3$ system. All 1-3 materials exhibited the rhombohedral $PuNi_3$-type structure. The 1-3 iron

compounds with thorium contents of approximately x = 0.5 or greater exhibited magnetic anomalies similar to those observed in the $Gd_{1-x}Th_xFe_3$ system. These consisted of abrupt magnetic transitions in magnetization vs temperature data and in measurements of magnetization vs applied field. Moessbauer measurements permitted the resolution of two of the three crystallographically inequivalent iron sites [3(b), 6(c), 18(h)] in the $PuNi_3$ structure. Low temperature specific heats revealed that replacement of trivalent Y with tetravalent Th in $Y_{1-x}Th_xFe_3$ causes a reduction in holes in the iron 3d band. On the basis of the experimental results a spin structure was proposed for the anomalous magnetic state. The magnetic transitions were postulated to be caused by a passage from antiferromagnetic to ferromagnetic alignment within the 18(h) iron sublattice. A possible theoretical basis for this spin structure transition was developed based on the Friedel model of magnetic interactions in transition metals. (Diss. Abstr. Int., B)

21726 THERMODYNAMIC PROPERTIES OF CARBON IN IRON AND IRON-MOLYBDENUM ALLOYS. Lobo, J. A. P. Chicago; University of Illinois (1973). 117p. University Microfilms Order No. 74-4643.

Thesis (Ph. D.).

A Cahn RG Electrobalance has been used to directly determine the carbon content of iron, iron–0.48 wt.% molybdenum and iron–1.16 wt.% molybdenum specimens which had been dynamically equilibrated with a series of methane–hydrogen gas mixtures of constant composition. The following equilibria were investigated: ferrite phases of the alloys at 682, 727, 753, 783, 813, and 848°C, and austenite phases of the alloys at 783, 813, and 848°C. The experimental results permitted direct calculation of the activities of carbon in the ferritic and austenitic samples, relative to graphite as unity, and of the enthalpy and entropy of solution of carbon. The results have been compared with the experimental measurements of a number of other investigators. In some cases the agreement is good; in others, it is not. In alpha-iron, the partial molar enthalpy and entropy of solution of carbon are 26100 calories and 28.556 calories/°K, respectively. The addition of molybdenum results in an increase in these properties, and the increase is found to be proportional to the molybdenum content. The partial molar enthalpy and entropy of solution of carbon are 28300 calories and 30.716 calories/°K, for alpha-iron containing 0.48 wt.% molybdenum. Corresponding values for the alloy with 1.16 wt.% molybdenum are 31300 calories and 33.679 calories/°K. The thermodynamic functions of carbon are dependent on the carbon concentration for gamma-iron and gamma-iron–molybdenum alloys. Empirical equations have been derived to relate these properties to the carbon content and temperature. The saturation solubility of graphite in the alpha-iron phase is 0.0176 wt.% at the eutectoid temperature and is lower than the value commonly accepted. Empirical equations have been derived to relate the limiting solubility of graphite in alpha-iron and alpha-iron–molybdenum alloys, to the temperature. (Diss. Abstr. Int., B)

21727 MECHANISMS OF DEFORMATION IN THE HOT WORKING OF NICKEL-BASE SUPERALLOYS. Fulop, S. (United Aircraft of Canada, Longueuil); McQueen, H. J. pp H1-H21 of Superalloys: Processing. Columbus, OH; Battelle Columbus Labs. (1972).

From second international conference on superalloys-processing; Champion, Pennsylvania, USA (18 Sep 1972).

See MCIC-72-10; CONF-720917-.

The mechanisms of hot deformation are dynamic recovery and dynamic recrystallization which control the flow stress developed and the rate of crack propagation. Through their subsequent interaction with static recovery and static recrystallization, which occur whenever the metal remains hot after deformation, they also determine the structure and properties either upon cooling or at entrance to another stage of deformation. As a preliminary step to understanding the deformation of precipitation-hardenable nickel-base superalloys, a review is made of the mechanisms observed in the simpler fcc alloys of iron, cobalt, and nickel. The hot-working behavior of superalloys is reviewed and analyzed in terms of the mechanisms. (7 figures, 85 references) (auth)

21728 EFFECTS OF HOT WORKING PRACTICE ON WASPALOY'S STRUCTURE AND TENSILE PROPERTIES. Bailey, R. E. (Special Metals Corp., New Hartford, NY). pp J1-J21 of Superalloys: Processing. Columbus, OH; Battelle Columbus Labs. (1972).

From second international conference on superalloys-processing; Champion, Pennsylvania, USA (18 Sep 1972).

See MCIC-72-10; CONF-720917-.

An experimental hot rolling program was executed in which the effects of preheat temperature, percent reduction, and finish temperature were investigated. Results revealed that (a) tensile strength is strongly dependent upon finish temperature and moderately dependent upon reduction, and (b) tensile ductility is strongly dependent on reduction and slightly dependent on finish temperature. Moreover, preheat temperature, in the range studied, is relatively unimportant, provided proper reductions with a satisfactory finish deformation temperature are employed. A generally finer grain size accounted for the somewhat higher tensile strengths of (a) the slab rolled from 2050°F and (b) the slab that received a heavy reduction. However, rather large tensile strength variations were found with little difference in grain size. The specimen intentionally finish deformed at 1940°F, which displayed the lowest tensile strength, possessed a γ' and dislocation structure considerably different from the specimen finish deformed at 1760°F, which exhibited the highest tensile strength. In addition, the specimen experiencing the heavy reduction schedule showed the best tensile ductility, presumably due to the low concentration of grain boundary phases. Although Waspaloy is categorized as a γ' precipitation-strengthened superalloy, its tensile strength is markedly influenced by the dislocation structure generated via thermal-deformation processing. (16 figures, 4 tables) (auth)

21729 EFFECT OF THERMOMECHANICAL PROCESSING VARIATIONS ON THE MECHANICAL PROPERTIES AND STRUCTURAL CHARACTERISTICS OF UNITEMP C-300. Kent, W. B. (Cyclops Corp., Bridgeville, PA). pp M1-M26 of Superalloys: Processing. Columbus, OH; Battelle Columbus Labs. (1972).

From second international conference on superalloys-processing; Champion, Pennsylvania, USA (18 Sep 1972).

See MCIC-72-10; CONF-720917-.

Unitemp C-300 is an experimental nickel-base high temperature alloy which has displayed very promising strength capabilities. The alloy was developed as a modification of the original NASA IIb alloy system, and was designed specifically for optimum properties in the 1200°F temperature range. In addition, recent studies have indicated the alloy responds favorably to full solution heat treatment and improved properties at higher temperatures. This paper summarizes studies conducted to establish the effects of several thermomechanical processing variations on mechanical properties, and also establishes the versatility of Unitemp C-300 for high- and low-temperature applications. In addition to the mechanical property data, supporting structural studies are described including optical microscopy and x-ray diffraction of extracted residues. (17 figures, 4 tables) (auth)

21730 EFFECTS OF ALUMINUM CONTENT AND HEAT TREATMENT ON GAMMA PRIME STRUCTURE AND YIELD STRENGTH OF INCONEL NICKEL–CHROMIUM ALLOY 706. Raymond, E. L.; Wells, D. A. (International Nickel Co., Inc., New York). pp N1-N21 of Superalloys: Processing. Columbus, OH; Battelle Columbus Labs. (1972).

From second international conference on superalloys-processing; Champion, Pennsylvania, USA (18 Sep 1972).

See MCIC-72-10; CONF-720917-.

An intermediate heat treatment at 1550°F used to improve the rupture ductility of Inconel alloy 706 had a varied effect on room-temperature yield strength of the alloy. The effect seemed to depend on very small differences in Al content. A study was made of the effects of variations in aluminum content and heat treatment on the yield strength of alloy 706. Samples having Al contents from 0.033% to 0.90% were studied after four different heat treatments. An explanation of the variations in yield strength was found in terms of changes in structure of gamma prime, gamma prime/lattice mismatch, and changes in modulus of elasticity. It was found that material age-hardened without the intermediate treatment is in a slightly underaged condition, and that yield strength of such material is a function of gamma prime particle properties. It was also found that material given the 1550°F intermediate treatment and then age-hardened is slightly overaged. The yield strength of overaged material is not a function of gamma prime properties but depends instead on matrix shear modulus and interparticle spacing of the gamma prime. (14 figures) (auth)

21731 EFFECT OF HEAT TREATMENT ON MICROSTRUCTURE AND TENSILE DEFORMATION CHARACTERISTICS OF UDIMET 520. Doi, H.; Shimanuki, Y. (Mitsubishi Metal Corp., Omiya City, Japan). pp O1-O14 of Superalloys: Processing. Columbus, OH; Battelle Columbus Labs. (1972).

From second international conference on superalloys-processing; Champion, Pennsylvania, USA (18 Sep 1972).

See MCIC-72-10; CONF-720917-.

Effect of age-hardening treatment of Udimet 520 on growth of γ' particles and the correlation between the resulting microstructure and tensile deformation characteristics were investigated. The observed variations of the room-temperature proof stress, strain-hardening coefficient, and internal friction with temperature and time of the age-hardening treatment can be explained if we take into account of the effect of transition in the mode of dislocation motion from shearing to by-passing as a result of coarsening of γ' particles. A quantitative analysis of the age-hardening of the alloy on the basis of the theoretical model by Brown et al. of shearing of

γ' particles by paired dislocations revealed that modification of the existing theory is necessary. Two types of serrated yieldings were found by elevated-temperature tensile testing: the analysis of the effect of temperature and strain rate suggests that one type of serration (referred to as Type A) which appears in the temperature range of 200 to 350°C corresponds to the dynamic strain aging due to Al and Ti atoms and another (Type B) which appears in the temperature range of 350 to 600°C to repeated shearing of γ' particles by moving dislocations. Analysis of the dependence of the elevated-temperature proof stress on the volume fraction of γ' phase and direct observations of γ'-dislocation interaction revealed that when the specimen is deformed at temperatures below 700°C, γ' particles of comparatively small sizes are invariably sheared by moving dislocations. (7 figures) (auth)

21732 INFLUENCE OF COLD REDUCTION AND HEAT TREATMENT ON THE PROPERTIES AND MICROSTRUCTURE OF ALLOY 718 FASTENER STOCK. Heacox, R. A. (Latrobe Steel Co., PA). pp P1-P33 of Superalloys: Processing. Columbus, OH; Battelle Columbus Labs. (1972).

From second international conference on superalloys-processing; Champion, Pennsylvania, USA (18 Sep 1972).

See MCIC-72-10; CONF-720917-.

An investigation was undertaken to define the property levels as they relate to (1) amount of cold reduction, (2) aging treatment, (3) prior solution treatment, and (4) bar size. Bars were solution treated at 1750 or 1840°F prior to cold drawing 20 to 50% to two (.875 and .375 in. round) bar sizes. Specimens from each bar were then given the conventional 1325 + 1150°F age or one of two modified aging cycles. One modified aging cycle, 1275 + 1150°F, was designed to produce optimum tensile strength; the other, 1450 + 1150°F, was designed to produce optimum stress-rupture properties. Light and electron metallographic studies were conducted to correlate structure with properties. Results indicated that: (1) Tensile and yield strengths and rupture ductility increase with increasing cold reduction, whereas tensile ductility and rupture strength decrease. (2) Aging treatment has a significant effect on properties. The 1275 + 1150°F cycle produces the best tensile and yield strengths. Optimum rupture properties result from use of the 1450 + 1150°F cycle. The best balance of mechanical properties, however, is obtained by using the conventional 1325 + 1150°F cycle. The conventional age (1325 + 1150°F) and one modified age (1450 + 1150°F) results in overaging at the higher cold reductions (40-50%). (3) Solution heat treating temperature does not have a significant effect on mechanical properties. (4) The .375 in. round bars exhibit higher tensile and yield strengths and rupture ductilities than the .875 in. round bars. (9 tables, 18 figures) (auth)

21733 DIRECTIONALLY SOLIDIFIED EUTECTICS AS HIGH TEMPERATURE FASTENERS. George, F. D. (United Aircraft Research Labs., East Hartford, CT). pp U1-U21 of Superalloys: Processing. Columbus, OH; Battelle Columbus Labs. (1972).

From second international conference on superalloys-processing; Champion, Pennsylvania, USA (18 Sep 1972).

See MCIC-72-10; CONF-720917-.

Directionally solidified eutectics are being examined as candidate materials for vanes and blades in advanced gas turbines. Because of the superior high temperature properties displayed by two such alloys, a program was initiated to determine the suitability of these materials (Ni_3Al-Ni_3Nb; (Co, Cr, Al)-(Cr, Co)$_7C_3$) for high-temperature fasteners. Material properties pertinent to fastener applications were determined as a function of temperature. These properties included shear parallel and perpendicular to the growth direction and torsion parallel to the growth direction. Several techniques were investigated for fabricating typical fastener shapes. These fabrication methods included grinding, creep forming and direct casting. Finally, a brief evaluation of the performance of the best fabricated fastener design was made. (16 figures, 6 tables) (auth)

21734 TENSILE EMBRITTLEMENT OF TURBINE BLADE ALLOYS AFTER HIGH-TEMPERATURE EXPOSURE. Chang, W. H. (General Electric Co., Cincinnati). pp V1-V41 of Superalloys: Processing. Columbus, OH; Battelle Columbus Labs. (1972).

From second international conference on superalloys-processing; Champion, Pennsylvania, USA (18 Sep 1972).

See MCIC-72-10; CONF-720917-.

The tensile ductility of three γ'-strengthened, Ni-base superalloys (René 77, 80, and 100) is found to be reduced by high-temperature exposure. The cause of tensile embrittlement was determined by studying the effects of exposure temperature, time, and atmosphere (air vs vacuum), testing atmosphere (air vs vacuum), strain rate, and protective coatings. Results show that tensile embrittlement is environment-related, caused by interactions of nitrogen and probably also oxygen with the grain-boundary γ' network which forms upon exposure as a result of the MC + $\gamma \rightarrow$ $M_{23}C_6 + \gamma'$ reaction. Two modes of interactions are identified. Static interactions result from contamination of the γ' network by inward diffusion of the interstitials, associated with an apparent activation energy of 67 kcal/mole. Dynamic interactions occur instantaneously during testing in air when the γ' network is exposed by surface cracking. The dissolution and/or adsorption of the interstitials is believed to lower the surface energy and fracture strength of the γ' phase. In the absence of environmental interactions, the intrinsic ductility of all three alloys is shown conclusively to be enhanced, rather than impaired, by high-temperature exposure. The effects of strain rate and protective coatings are studied. High strain rates aggravate tensile embrittlement by altering the sites of crack initiation and propagation. The efficacy of three types of coating in mitigating environmental interactions is illustrated and discussed in terms of coating composition, microstructure, thickness, and ductility. (25 figures) (auth)

21735 CELESTIAL LIMITS OF NICKEL-BASE SUPERALLOYS. Tien, J. K. (Columbia Univ., New York). pp W1-W16 of Superalloys: Processing. Columbus, OH; Battelle Columbus Labs. (1972).

From second international conference on superalloys-processing; Champion, Pennsylvania, USA (18 Sep 1972).

See MCIC-72-10; CONF-720917-.

The question of the upper limits to the mechanical properties of Ni-base superalloys is considered. Yield strength, creep, and fatigue are considered. It is suggested that a near-ideal Ni-base superalloy for gas turbine applications is a plane front solidified, thermomechanically treated, gamma prime matrix crystal strengthened by gamma particles and inert dispersoids. (DLC)

21736 DIRECTIONALLY RECRYSTALLIZED TD NiCr. Allen, R. E. (General Electric Co., Cincinnati). pp X1-X22 of Superalloys: Processing. Columbus, OH; Battelle Columbus Labs. (1972).

From second international conference on superalloys-processing; Champion, Pennsylvania, USA (18 Sep 1972).

See MCIC-72-10; CONF-720917-.

A solid-state crystal-growing process named ZAP (Zone Aligned Polycrystals) was developed which is capable of producing either columnar oriented crystals or monocrystals from as-extruded TD NiCr. Stress rupture testing of columnar grained bars in which the (001) planes are perpendicular to the stress axis indicate that this material is approximately twice as strong as the same as-extruded product given a conventional recrystallization heat treatment. Specimens from three different mill shapes were successfully ZAP processed: extruded round bar, extruded sheet bar, and sheet. ZAP process rates increase with increasing recrystallization temperatures and the maximum rate achievable is therefore dependent upon prior processing. Stress-rupture ductilities in round bar are also improved by ZAP processing; i.e., 6-7% elongation vs 1-2% in conventionally processed bar. Although the majority of the work has been conducted on TD NiCr, the process is also applicable to other dispersion strengthened alloys. (12 figures) (auth)

21737 NUCLEAR FUELS AND NUCLEAR MATERIALS. Ursu, I. (Institutul de Fizica Atomica, Bucharest). pp 337-366 of Energia Atomica. Bucharest; Editura Stiintifica (1973). (In Rumanian).

The main component part of the nuclear reactors is represented by the fuel and the other nuclear materials which are produced in a complex technological process. The nuclear materials, as well as their properties are extensively discussed in Chapter 12 of the book "Atomic Energy". The neutron moderators and reflectors, coolants, control nuclear protection and structural materials are also described. At the end of the chapter, the reprocessing possibilities and methods of the nuclear fuel processing are discussed. (INIS)

21738 CAVITY GROWTH IN THE HIGH TEMPERATURE CREEP PROCESS OF PURE AND DOPED TUNGSTEN WIRES. Horacsek, O. (Magyar Tudomanyos Akademia, Budapest. Muszaki Fizikai Kutato Intezet). Z. Metallkd.; 65: No. 4, 318-323 (Apr 1974).

10 figs.; 13 refs.

Emission-microscopic examinations carried out simultaneously with creep deformation showed that at low stresses, both pure and doped tungsten wires rupture at high temperature because of the formation and growth of grain boundary cavities. The nuclei of the grain boundary cavities causing the rupture in the pure wires are microcracks, which form continuously during the creep deformation. The nuclei of the creep cavities forming in the doped material are already present at the beginning of the creep process, since these are the potassium bubbles which form as a result of the doping and affect the recrystallization. Accordingly, creep cavities are formed in the doped material not only on the grain boundaries, but also inside the grains. On the basis of the different nature of the nuclei of the cavities and also on the basis of the different growth mechanism, it is possible to interpret the

extremely large differences observed between the creep ductilities of the two materials which barely differ from each other chemically. (GE)

21739 MODIFIED BHATIA'S MODEL FOR THE LATTICE DYNAMICS OF TRANSITION (hcp) METALS. Kushwaha, S. S. (Banaras Hindu Univ. India). J. Phys., F (London); 4: No. 5, 663-670(May 1974).

The effective interaction within the transition metals is split into the central interaction between the ions and the ion-electron interaction. The former contribution is accounted for by taking central forces up to the fourth neighbors in Ti and Hf and up to the fifth neighbor in Y. The latter contribution is, however, obtained following Bhatia's (Bhatia, A. B., 1955, Phys. Rev., 92: 363-70) method on cubic metals. Phonon dispersion relations along symmetry directions and $\theta - T$ curve have been plotted and compared with the available experimental results. (auth)

21740 PHASE EQUILIBRIA AND PROPERTIES OF ALLOYS OF THE V_3Sn-Ti_3Sn SECTION OF THE V-Ti-Sn SYSTEM. Marchukova, L. V.; Matveeva, N. M.; Kornilov, I. I. pp 95-98 of Khimiya Metal. Splavov. Moscow; Izdatel'stvo Nauka (1973). (In Russian).

Measurements of hardness, microhardness, and thermo-emf, as well as x-ray diffraction microscopy and thermal microstructural analysis, were used to construct the polythermal V_3Sn-Ti_3Sn section of the V-Ti-Sn system. The compounds V_3Sn and Ti_3Sn (δ and γ phases, respectively) are in equilibrium in the solid state, forming a quasibinary system with limited solid solutions. At 1200°C the solubilities of Ti in the δ and of V in the γ phase are 47.3 and 20.0 at. %, respectively, these figures showing no significant decrease as the temperature is lowered. The changes in properties across the section from V_3Sn to Ti_3Sn indicate gradual changes in both the type of conductivity and the type of bonding, i.e., from hole to electronic and from primarily covalent (V_3Sn) to primarily metallic (Ti_3Sn). (Ref. Zh.)

21741 SOME PHYSICAL PROPERTIES OF COMPOSITE MATERIALS OF THE COPPER/TUNGSTEN FIBRE TYPE. Ivan, J.; Sebo, P.; Taborsky, L.; Havalda, A. Kovove Mater.; 11: No. 3, 228-236(1973). (In Slovak).

Electrical resistance, thermal conductivity, thermal longitudinal extension, and sp gr of the composite material from Cu with W fibers up to 30 vol % were measured. Samples of ~4 mm dia, 50 mm long, were prepared from 0.2 mm dia W fibers by casting with 99.95 pure Cu along the fibers. Holes 0.2 mm dia were provided for thermocouples. A schematic diagram of the arrangement of resistivity measurement and plots are shown. All measurements were carried out in the direction of fibers. The electrical resistivity increases linearly with vol % of W, and the thermal conductivity and longitudinal thermal expansion (at 25 to 400°C) decrease with the vol % of W. The sp gr increases linearly with the W content. The physical properties of fiber-type Cu/W composite are better than those produced by powder metallurgy. (Metals Abstr.)

21742 EFFECT OF SURFACE FINISH ON THE NORMAL SPECTRAL EMITTANCE OF Mo BETWEEN 1000 AND 2400°K. Baria, D. N.; King, T. S.; Bautista, R. G. (Ames Lab., IA). High Temp. - High Pressures; 5: No. 5, 545-549(1973).

The normal spectral emittance ($\lambda = 0.645\ \mu m$) of molybdenum was determined for electrochemically polished, mechanically polished, and 60 grit ground surfaces between 1000 and 2400°K at pressures below 10^{-6} torr. An empirical equation of the type $\epsilon_{n\lambda} = AT^B$ expCT was fitted separately to the data obtained during the heating and the cooling cycles for each of the three surface finishes studied. (auth)

21743 PRESENT SUPPLY-DEMAND SITUATION OF NIOBIUM. Takai, T. (Mitsui Mining and Smelting Co. Ltd., Tokyo). Cryogenics; 14: No. 6, 301-306(Jun 1974).

Niobium is becoming well known as the principal material of superconductivity. It has been used as an additive in steel for the past twenty years; in many well known fields it is now extensively used as an industrial material. An outline is given of the raw materials, metallurgical processing, production, and uses of niobium based, as much as possible, upon statistical data. (auth)

21744 DETERMINATION OF GRAIN SIZE IN U-Cr ALLOYS BY ULTRASONIC ATTENTUATION. Roman, I.; Oron, M.; Pesach, J.; Rosen, M. (Hebrew Univ., Jerusalem). J. Mater. Sci.; 9: No. 4, 630-634(Apr 1974).

Ultrasonic attenuation was measured in cylindrical samples of uranium-chromium alloys used for nuclear fuel elements. The grain structure of the samples was previously refined by proper heat-treatment and the grain size in the range of 50 to 200 μm was determined by conventional metallographic methods. The attenuation coefficient, γ, was correlated with the mean grain diameter, $\bar{D}$, for three ultrasonic frequencies: 4, 6 and 12 MHz. The experimental results were compared with existing theories and good agreement was found with the curves based on Merkolov's analysis for cubic metals. A more practical result of this work was the development of a non-destructive testing procedure for grain-size determination in nuclear fuel elements cast from these alloys. The highest frequency (12 MHz) is normally used as it is more sensitive in the lower grain-size limit (50 to 100 μm) and only in border-line cases would one switch to the other frequencies (6 and 4 MHz) which are more applicable to the higher grain-size limit (100 to 200 μm). (auth)

21745 AVERAGE MICROHARDNESS OF MULTI-PHASE ALLOYS. Fedotov, A. K. (Inst. of Solids and Semiconductors, Minsk). Vestsi Akad. Navuk BSSR, Ser. Fiz.-Tekh. Navuk; No. 2, 28-30(1974). (In Russian).

The utility of the microhardness H_μ^{cp}, averaged for the samples, as a characteristic of the macroscopic hardness of heterogeneous alloys was shown theoretically and experimentally. Empirical formulas connecting H_μ^{cp} and the Rockwell hardness of ternary alloys of the V-Nb-Cr system were obtained. (tr-auth)

21746 LANTHANUM-IRON-SILICON SYSTEM. Bodak, O. I.; Gladishevskii, E. I. Visn. L'viv. Derzh. Univ., Ser. Khim.; No. 14, 29-34(1972). (In Ukrainian).

X-ray and microscopic analyses were used to establish the La-Fe-Si equilibrium diagram at 600°C. The existence of three known compounds was confirmed, i.e. $LaFe_{11.3-9.4}Si_{1.7-3.2}$ of lattice type $NaZn_{13}$ with a = 11.45 to 11.34 and c = 11.45 to 11.61 Å; LaFeSi of lattice type PbFCl with a = 4.052 and c = 7.179 Å; and $LaFe_{0.3-0.5}Si_{1.7-1.5}$ of lattice type AlB_2 with a = 4.066 to 4.102 and c = 4.378 to 4.324 Å. Two new compounds were formed: $LaFe_2Si_2$ of lattice type $CeGa_2Al_2$ with a = 4.042 and c = 10.14 Å, and $LaFe_{1.3}Si_{2.7}$ of unknown structure. The solubility of Fe in $LaSi_2$ is 7.0 at. % at 600°C. (Ref. Zh.)

21747 X-RAY STUDY OF THE ERBIUM-IRON-ALUMINUM SYSTEM FOR ERBIUM CONTENTS UP TO 33.3 at. %. Zarechnik, O. S.; Vivchar, O. I.; Ryabov, V. R. Visn. L'viv. Derzh. Univ., Ser. Khim.; No. 14, 16-19(1972). (In Ukrainian).

X-ray analysis was used to study the Er-Fe-Al system with Er 0 to 33.3 at. % and to construct an isothermal section at 500°C. Four ternary compounds (i) to (iv) and four solid solutions exist in this region: (i) $ErFe_{4.0-5.6}Al_{8.0-6.4}$ (ψ phase, $ThMn_{12}$ structure); (ii) $Er_2Fe_{11}Al_5$ (φ_2 phase, Th_2Zn_{17} structure); (iii) $ErFe_{1.2}Al_{0.8}$ (λ_1 phase, $MgZn_2$ structure); and (iv) $ErFe_2Al_{10}$ (ψ phase, structure not established). The solid solutions are based on the binary compounds $Er_2Fe_{17.0-10.0}Al_{0-7.0}$ (φ_4 phase, Th_2Ni_{17} structure), $Er_6Fe_{23.0-14.5}Al_{0-8.5}$ (τ phase, Th_6Mn_{23} structure), $ErAl_{2.0-0.4}Fe_{0-1.4}$ ($\lambda_{3(Al)}$ phase, $MgCu_2$ structure), and $ErFe_{2.0-1.6}Al_{0-0.2}$ ($\lambda_{2(Fe)}$ phase, $MgCu_2$ structure). (Ref. Zh.).

21748 PRECIPITATION PROCESSES OCCURRING IN THE HEAT AFFECTED ZONE OF THE WELDING SEAM OF THE 22Ni-Mo-3,7Cr REACTOR STEEL. Leiber, F. (August Thyssen-Huette AG, Duisburg, Ger.); Dittrich, S.; Grosse-Woerdemann, J. Thyssenforschung; 5: No. 2, 98-104(1973). (In German).

The precipitates in the steel and in the welded joints subsequent to the manual electric welding and the submerged arc welding, both in the as-welded state and subsequent to annealing, with and without load were examined. Welding simulation tests were according to Gleeble. Descriptions of the carbide and nitride precipitation states are included. (GE)

21749 SEAMLESS AND WELDED CHROMIUM-NICKEL-IRON-MOLYBDENUM-COPPER-COLUMBIUM STABILIZED ALLOY PIPE. Philadelphia; American Society for Testing and Materials (1973). 6p. (ASTM-B-464-73).

This specification covers alloy pipe intended for high-temperature and general corrosive service. The composition is 19 to 21% Cr, 32 to 38% Ni, balance Fe, 2 to 3% Mo, 3 to 4% Cu, and up to 1% Nb + Ta. Manufacture, chemistry, mechanical properties, flattening and other tests, permissible variations in dimensions, testing, etc. are covered. (auth)

21750 TITANIUM AND ALLOY SURFACES FOR ADHESIVE BONDING. Allen, K. W.; Alsalim, H. S. (The City Univ., London). J. Adhes.; 6: No. 3, 229-237(1974).

The nature of the oxide on the surface of titanium and the Ti-6Al-4 V alloy after a number of recommended treatments was examined by x-ray and electron diffraction. No evidence for material other than titania in its rutile form was obtained even though anatase and fluoride have been reported. The most efficient surface for adhesive bonding is a rough surface of the black oxide such as is produced by treatment of the metal in alkaline hydrogen peroxide. (7 figures) (auth)

21751 QUANTITATIVE STRAIN-AND-STRESS STATE CRITERION FOR FAILURE IN THE VICINITY OF SHARP CRACKS. Walker, T. J. (Westinghouse Electric Corp., West Mifflin, PA). Nucl. Technol.; 23: No. 2, 189-203(Aug 1974).

A quantitative strain-and-stress state criterion for failure has been developed which is applicable in the vicinity of sharp cracks. This criterion is applicable to any example which may be represented by finite element theory in the detail required to determine the strain-and-stress state for the crack tip region. The restriction of linear elastic fracture mechanics which defines a minimum crack length is removed, since the influence of the free boundary in the vicinity of the crack is included in the finite element solution. The development of the criterion includes an experimental base and demonstrates the applicability for the conditions of a sharp fatigue crack and for a blunt machined notch with an ~0.001-in. tip radius. (auth)

21752 CRYSTAL STRUCTURE OF INTERMETALLIC PHASES WNi_3 AND $MoNi_3$. Arapova, L. P. (Saratov Polytechnical Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 8, 147-150(1973). (In Russian).

A study was conducted to determine accurately the crystal structure of WNi_3 and $MoNi_3$ phases which separate out in the corresponding alloys after deformation and annealing at 1100°C for ½, 1, 2, 5, and 18 hours. The nickel alloy containing 25 at. % tungsten in the initial state consisted of two phases — an alpha face-centered cubic and a gamma body-centered cubic phase, while the nickel alloy containing 25 at. % Mo was single phase consisting of an alpha, face-centered cubic phase. For the WNi_3 phase the following values were obtained for the lattice parameters: a = 4.91, b = 4.22, c = 4.39 Å, and V_{cell} = 90.90 Å^3. The roentgenograms of WNi_3 and $MoNi_3$ differ only in the number of lines. (SJR)

21753 RESISTIVITY OF VR-5 AND VR-10 TUNGSTEN–RHENIUM ALLOYS AT 1200 TO 3000°K. Vertogradskii, V. A.; Chekhovskii, V. Ya. (Inst. of High Temperatures, Moscow). High Temp. (USSR) (Engl. Transl.); 11: No. 2, 386-387(1973).

Translated from Teplofiz. Vys. Temp.; 11: No. 2, 433-434(1973).

The alloy specimens were produced by powder metallurgy methods and contained 5 or 10% Re. The specimens were heated at 2500°C for one hour before the measurements. Results are presented in a table and a graph and discussed. (JRD)

21754 EFFECT OF SMALL ADDITIONS OF RUBIDIUM ON ELECTRICAL RESISTANCE OF LIQUID SODIUM. Savchenko, V. A.; Shpil'rain, E. E. (Inst. of High Temperatures, Moscow). High Temp. (USSR) (Engl. Transl.); 11: No. 3, 606-609(1973).

Translated from Teplofiz. Vys. Temp.; 11: No. 3, 671-674(1973).

The effects of small additions of Rb on the electric conductivity of Na at 100 to 1100°C were studied for Rb concentrations of 0.3, 0.77, 1.20, 2.24, 3.00 and 4.51 at. %. Results are presented tabularly and discussed. (JRD)

21755 THERMAL PROPERTIES OF LANTHANIDES AT HIGH TEMPERATURES. Novikov, I. I.; Mardykin, I. P. (Inst. of Metallurgy, Moscow). High Temp. (USSR) (Engl. Transl.); 11: No. 3, 472-476(1973).

Translated from Teplofiz. Vys. Temp.; 11: No. 3, 527-532(1973).

Results of measurements are presented on the specific heat at constant pressure and the thermal diffusivity of liquid cerium in the temperature range 1100 to 1700°K. Data on electrical conductivity of solid and liquid cerium and of solid yttrium in the range from about 500 to 1700°K are also presented. Information on the thermal properties was obtained by means of an apparatus based on the use of the radial-temperature wave method. The behavior of these properties is discussed, along with the thermal conductivity and Lorentz number of elements of the lanthanide series. (auth)

21756 MAGNETIC BREAKDOWN IN NIOBIUM IN STRONG MAGNETIC FIELDS. Alekseevskii, N. E.; Bertel, K. H.; Nizhankovskii, V. I. (International Lab. for Strong Magnetic Fields and Low Temperature, Wroclaw). JETP Lett. (USSR) (Engl. Transl.); 19: No. 2, 72-73(20 Jan 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 19: No. 2, 117-120(20 Jan 1973).

The magnetoresistance of ultrapure niobium was investigated in fields up to 170 kOe. Magnetic breakdown, leading to a change of open trajectories into closed ones, was observed. An analysis of the experimental results within the framework of the coherent model yields a breakdown field $H_0 \approx 280$ kOe. (auth)

21757 COMPTON PROFILES OF BERYLLIUM AND GRAPHITE. Tsvetkov, V. P.; Shevtsov, L. V. (Mining and Metallurgical Inst., Moscow). Sov. Phys.-Solid State (Engl. Transl.); 15: No. 10, 2047-2049(Apr 1974).

Translated from Fiz. Tverd. Tela; 15: No. 10, 3074-3075(Oct 1973).

Samples of graphite and Be were investigated by exposure to an entire polychromatic x ray beam. Scattered rays were directed to an analyzer crystal. The measurements were carried out by scanning using an SSD counter in steps of 5′ (in some cases in steps of 3′). The intensity of the scattering was determined for each angle by summing the pulses collected in 25 min. The error in the determination of a Compton peak did not exceed 1% and the background was determined to within 3%. The compton profiles of graphite and Be obtained in this way are plotted. The scattering angle was $2\theta_k = 105°$ for both materials. After prolonged irradiation with x rays the LiF analyzer crystal exhibited traces of color but there was no significant change in the scattering intensity. Since the atoms of carbon had both strongly and weakly bound electrons, two lines were expected and observed, one with unchanged wavelength $K\alpha_{1,2}$ and the other with a modified wavelength λ'. Scattering angles exceeding 105° were unattainable in the apparatus and, therefore, a considerable overlap of the Compton profiles with the $K\alpha_{1,2}$ lines of molybdenum was observed. The Compton profile was found by averaging the variations of the wavelength of the characteristic doublet of molybdenum. In view of this the profiles were slightly asymmetric. (JRD)

21758 X RAY EMISSION, M_v- AND $N_{II,III}$-BANDS OF Nb AND Mo. Geguzin, I. I.; Al'perovich, G. I.; Nikiforov, I. Ya. (Rostov-on-Don State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 8, 103-106(1973). (In Russian).

The electron structure and soft x ray spectra of molybdenum and niobium are computed. From the agreement attained between the theoretical and experimental spectra it was possible to give an interpretation to the M_v- and $N_{II,III}$-emission bands of Nb and Mo. From the x ray emission bands of different series it is possible to visualize the wave functions of valence band electrons, and by the same way, to pass judgment on the accuracy of the zone calculation. (SJR)

21759 SOME PHYSICAL PROPERTIES OF A NEW ALLOY IN THE NICKEL–RHENIUM–MOLYBDENUM SYSTEM. Peletskii, V. E.; Chekhovskoi, V. Ya.; Savitskii, E. M.; Tylkina, M. A.; Amasovich, E. S.; Arskaya, E. P.; Zaichenko, V. M.; Petukhov, V. A. (Inst. of High Temperatures, Moscow). High Temp. (USSR) (Engl. Transl.); 11: No. 2, 388-389(1973).

Translated from Teplofiz. Vys. Temp.; 11: No. 2, 435-436 (1973).

The thermal conductivity, thermal expansion, and specific resistance were measured for an alloy with 10 wt. % Re and 15 wt. % Mo, which was made by arc melting in helium in a water-cooled crucible. All the measurements were made at 10^{-6} mm Hg on the same rod specimen, whose geometry was gradually altered in accordance with the design of that section of the equipment. Results are presented graphically and discussed. (JRD)

21760 PHYSICAL PROPERTIES OF AN In–Ga–Ag ALLOY OF EUTECTIC CONCENTRATION. Prokhorenko, V. Ya.; Pazdrii, I. P.; Ratushnyak, E. A.; Stadnyk, B. I.; Lakh, O. I. (Lvov State Univ.). High Temp. (USSR) (Engl. Transl.); 11: No. 2, 390-391(1973).

Translated from Teplofiz. Vys. Temp.; 11: No. 2, 437-438 (1973).

The temperature dependence of the electrical conductivity, thermal conductivity, and density for In–Ga–Ag eutectic is reported. A phase diagram has been derived from microstructure, x-ray, and thermal studies; the system contains compounds that melt incongruently with peritectic transitions. The eutectic of lowest melting point, 14.5°C, is formed at 24 wt. % In + 74 wt. % Ga + 2 wt. % Ag. All the alloys in the system show supercooling. The material was made by melting the components under vacuum at 900°C with ultrasonic agitation. The silver dissolved completely, but after a while a solid was deposited at the bottom of the crucible, which may be taken as a metastable phase in view of the composition of the eutectic, which is all the more likely because there are peritectic transformations near the eutectic. The resistivity was measured in the working part of a resistance thermometer, whose improved design reduced the error to ±0.2%. The results are presented in tables and graphs and discussed. (JRD)

21761 RARE EARTH METAL-COBALT PERMANENT MAGNETS WITH PRASEODYMIUM. Johnson, R. E.; Fellows, C. J. (Permanent Magnet Association, Sheffield (UK). Central Research Lab.). Kobalt; No. 1, 20-23(1974). (In German).

3 figs.; 2 tabs.; 10 refs.

Work in the field of RCo_5 permanent magnet alloys based on samarium-containing compounds is reported. The maximum energy product of such magnets is normally between 120 and 160 kJ/m^3, which can be improved to a maximum of 208 kJ/m^3 by substituting praseodymium for part of the samarium in the

alloy. A simple method has been found for achieving excellent magnetic properties with $Pr_xSm_{1-x}Co_5$ alloys. By carefully selecting the two crucial parameters (composition of the alloy and amount of sintering material to be added for sintering in the liquid phase as well as sintering temperature), a maximum energy product of 176 kJ/m^3 has been achieved with an alloy consisting of 30.5% Pr, 9% Sm and 60.5% Co. However, after a storage period of 18 months at room temperature, the magnets are found to have deteriorated considerably, part of them have been physically decomposed. The reason of this phenomenon has not yet been fully discovered; it is assumed that a reaction of rare earth metals with oxygen and/or nitrogen may be involved. Possible ways of avoiding this effect and improving the storage properties at room temperature by improved sintering techniques are discussed. (GE)

21762 SOLUBILITY OF HYDROGEN IN THE SYSTEMS Ti–Al–H, Ti–V–H AND Ti–Al–V–H IN THE TEMPERATURE RANGE 800 TO 1,000°C AND AT HYDROGEN PRESSURES BETWEEN 0.1 AND 520 MBAR. P. 1. Theory and Experimental Results. Schuermann, E.; Kootz, T.; Preisendanz, H.; Schueler, P.; Kauder, G. (Deutsche Edelstahlwerke A. G., Krefeld (F. R. Germany). Forschungsinstitut). Z. Metallkd.; 65: No. 3, 167-172(Mar 1974). (In German).

5 figs.; 32 refs. Part of a diss. by Kauder, G.

A description is given of an experimental rig for activity measurements by a gravimetric method, measurement of the pressure-dependent hydrogen solubility in titanium-aluminium, titanium-vanadium and titanium-aluminium-vanadium-alloys with 0 to 6% Al and/or 6% V in the temperature range 800 to 1,000°C and at hydrogen pressures between 0.1 and 520 mbar. (GE)

21763 SOLUBILITY OF HYDROGEN IN THE SYSTEMS Ti–Al–H, Ti–V–H AND Ti–Al–V–H IN THE TEMPERATURE RANGE FROM 800 TO 1,000°C AT HYDROGEN PRESSURES OF 0.1 TO 520 MBAR. P. 2. Thermodynamic Evaluation. Schuermann, E.; Kootz, T.; Preisendanz, H.; Schueler, P.; Kauder, G. (Deutsche Edelstahlwerke A. G., Krefeld (F. R. Germany). Forschungsinstitut). Z. Metallkd.; 65: No. 4, 249-255(Apr 1974). (In German).

5 figs.; 3 refs. Part of a diss. by Kauder, G.

Determination of thermodynamic properties such as enthalpy of solution and entropy of solution; effectivity parameter and equivalence factor; suggestions for the ternary systems Ti–Al–H and Ti–V–H for temperatures from 800 to 1,000°C in the titanium-rich corner with respect to hydrogen iso-activities. (orig.)

21764 REVIEW OF THE BINARY SYSTEMS OF COBALT WITH RARE EARTH METALS. Ray, A. E. (Dayton Univ., Ohio (USA). School of Engineering). Kobalt; No. 1, 12-19(1974). (In German).

13 figs.; 49 refs.

Based upon the data given in 49 publications as well as on findings of investigations performed by the author, a survey is given of the present state of structural studies on the binary systems of cobalt with rare earth metals. The review is restricted to the systems of cobalt with yttrium and the light rare earth metals (La, Ce, Pr, Nd and Sm), as these elements are most likely to be used in the fabrication of permanent magnets. The equilibrium data available for each system, the formation mechanism, lattice constants, and solubility data of the various intermetallic compounds are discussed. Each section is supplemented by a brief outline of possible and actual advantages of the particular alloy with regard to its use as a material for permanent magnets. (GE)

21765 SOLUBILITIES OF TITANIUM ALLOYS AND ALLOY STEELS IN LIQUID INDIUM AND LIQUID INDIUM–GALLIUM ALLOY. Zakharov, D. M.; Yatsenko, S. P.; Kiknadze, G. I.; Mel'nikova, L. V.; Dieva, E. N.; Danelyan, E. P. Sov. At. Energy (Engl. Transl.); 35: No. 3, 847-849(Sep 1973).

Translated from At. Energ. (USSR); 35: No. 3, 202-204(Sep 1973).

Specimens of Ti, Ti alloys, and alloy steels were exposed to liquid In–Ga alloy at about 350°C for 50 to 3500 h. Results of the tests are presented graphically and analyzed. (JRD)

21766 POLYCRYSTAL VERSUS SINGLE-CRYSTAL STRAIN RATE SENSITIVITY OF CADMIUM. Prasad, Y. V. R. K.; Armstrong, R. W. (Maryland Univ., College Park). Phil. Mag.; 29: No. 6, 1421-1425(Jun 1974).

Taking polycrystalline cadmium as an example and by utilizing the predicted temperature or strain rate-dependence of the (Hall-Petch) stress-grain size parameters, a reasonably quantitative explanation is given for the grain size dependence of apparent activation volume measurements. The explanation involves the theoretical relation of these measurements to single-crystal measurements. (auth)

21767 X-RAY FOURIER LINE SHAPE ANALYSIS IN COLD-WORKED HEXAGONAL ZIRCONIUM. Chatterjee, S. K.; Sen Gupta, S. P. (Indian Association for Cultivation of Science, Calcutta). J. Mater. Sci.; 9: No. 6, 953-960(Jun 1974).

Detailed Fourier analysis of line shapes has been carried out in hexagonal zirconium metal in the cold-worked and partially recovered states. X-ray diffraction profiles from the fault-unaffected 10.0, 00.2, 11.0, 11.2 and 00.4 and fault-affected 10.1, 10.3, 20.1, 10.2, and 20.2 reflections have been recorded using a counter diffractometer. The line shape analysis has shown small anisotropy as regards the domain sizes and strains, the average values being of the order of 280 A and 2.08×10^{-3} A respectively in the cold-worked state with a small recovery at a higher temperature. Least-square solution applied to fault-affected reflections has yielded very small concentration of deformation faults with a negligible proportion of growth faults. Results are found to be consistent with earlier x-ray measurements and recent electron microscope investigations on zirconium. (auth)

21768 AGING OF Cu–Zr AND Cu–Al–Zr ALLOYS. Bushnev, L. S.; Payuk, V. A.; Korotaev, A. D. Fiz. Metal. Metalloved.; 37: No. 3, 573-579(Mar 1974). (In Russian).

The mechanics of aging of Cu–Zr and Cu–Al–Zr containing up to 7 wt % Al was studied by translucence microscopy. With Zr concentration up to 0.15 wt %, alloys cooled from 970°C aged with separation of a coherent plate-like phase of the usual {100} plane based on α–Zr with an hcp lattice. Separation of α phase was accompanied by an increase in defects of the injection of low-temperature aging. (tr-auth)

21769 MICROSTRUCTURE AND STRENGTH OF EUTECTIC Fe–Fe_2Zr. Reznichenko, V. V.; Somov, A. I.; Tihonovskii, M. A. (Physical-Technical Inst., Kiev). Fiz. Metal. Metalloved.; 37: No. 3, 657-659(Mar 1974). (In Russian).

The effect of crystallization conditions and composition of a Fe–Fe_2Zr melt on the microstructure and strength of the material was studied. When crystallization rates were varied from 0.4 to 11 cm/hr, the dependence of λ on the rate agreed with theory. The difference in crystal shape of Fe(Zr) and Fe_2Zr indicates a difference in the mechanism of their growth. For high-strength eutectics, it is necessary to remove all impurities which might cause variations in the crystallization rate. (auth)

21770 TENSILE DESTRUCTION OF Mo DUE TO STRUCTURE FRAGMENTATION. Rybin, V. V.; Vergazov, A. N.; Likhachev, V. A. Fiz. Metal. Metalloved.; 37: No. 3, 620-624(Mar 1974). (In Russian).

The appearance of ruptures in 99.9% pure Mo samples destroyed under uniaxial tension at room temperature was studied. The samples, with an initial subgrain or recrystallized structure, were destroyed with a clearly expressed neck upon constriction to around 70%. The coarse nature of the distribution was observed for both types of samples. Analysis of the dislocation structures showed that in both materials fragmentation developed with plastic deformation. Close to the surface of the ruptures, at the boundaries of the fragments, in places of three or four junctions there were large numbers of microcracks. A qualitative model is presented for destruction in a fragmented crystal based on assumptions concerning production of microcracks in places of local change in displacement vectors as a result of accumulation of incompatibility defects and the resulting coarse distribution of cracks along the fragment boundaries. (tr-auth)

21771 CONSOLIDATION OF CONCENTRATED IN INTERSTITIAL SOLUTIONS. Shtremi, M. A. (Moscow Inst. of Steel and Alloys). Fiz. Metal. Metalloved.; 37: No. 3, 608-612(Mar 1974). (In Russian).

The concentration coefficient of strengthening, K, was determined for high concentrations of interstitial additives (~1%) in solid solutions on the basis of bcc, fcc, and hcp metals. For all bcc metals, there is a single linear dependence of K on the product of the modulus of elasticity times the concentration deformation of the lattice. The temperature dependence, K(T), is steeper in the fcc lattice. The effect of the lattice type on K(T) is related to the difference in the nature of the interaction of dilitation centers and elastic dipoles with dislocations. (tr-auth)

21772 STRUCTURAL DEFECTS AND DIFFUSION IN EUTECTIC ALLOYS OF Ni_3AL–Ni_3Nb. Bokshtein, S. Z.; Gubareva, M. A.; Kishkin, S. T.; Moroz, L. M. (All-Union Inst. of Aviation Materials, Moscow). Fiz. Metal. Metalloved.; 37: No. 3, 565-572(Mar 1974). (In Russian).

High-resolution autoradiography was used to study structural defects and diffusion of Ni in Ni_3Al–Ni_3Nb alloys. Diffusion penetrability of surfaces increased—of grain boundaries, phase boundaries, subboundaries. Diffusion at the γ'-δ phase boundaries depended on the shape of the plates, being minimum with normal shape, and differed for the different phases of the eutectic. (tr-auth)

21773 EFFECT OF Fe AND Zr ON THE STRUCTURE AND ELECTRICAL RESISTANCE OF ALLOY 35 BT. Kadykova, G. N.; Kurshenina, I. I.; Fedotov, L. N. (Moscow Inst. of Electronic Machine Construction). Fiz. Metal. Metalloved.; 37: No. 3, 554-559(Mar 1974). (In Russian).

The effect of adding up to 7.7% Zr and 0.7% Fe on the properties of alloy 35BT (35% Nb) was studied. Both additives, especially Fe, were in the ω phase in colloidal deformed samples, annealed at 400°C. Under 7-9 kbar pressure, the electrical resistance increased, probably as a result of ω-phase formation. No increase in resistance with pressure was observed in the alloy with 3% Zr. (tr-auth)

21774 GROWTH OF EUTECTIC AND EUTECTOID COMPOSITES. Chadwick, G. A. (Univ. of Queensland, Australia). pp 25-43 of Conference on in situ Composites. Vol. I. Washington, DC; National Academy of Sciences (1973).

From conference on in situ composites; Lakeville, Connecticut, USA (5 Sep 1972). See NMAB-308-1; CONF-7209117-P1.

A summary of the recent theoretical and experimental work on the growth mechanisms and attendant morphologies of alloys of eutectic, off-eutectic, eutectoid and off-eutectoid compositions is presented. Certain sets of empirical data on the quantitative growth characteristics, interfacial free energies and nucleation behavior of these alloys are discussed at length both in relation to established theoretical treatments and more radical, pragmatic interpretations not following conventional orthodoxy. Information is included on several binary alloys including Bi-Cd, and Cd-Pb. (auth)

21775 THERMAL STABILITY OF UNIDIRECTIONALLY SOLIDIFIED Co-Co_3Cb EUTECTIC. Arnson, H. L. (Air Force Materials Lab., Wright-Patterson AFB, Ohio); Albright, D. L. pp 265-279 of Conference on in situ Composites. Vol. I. Washington, DC; National Academy of Sciences (1973).

From conference on in situ composites; Lakeville, Connecticut, USA (5 Sep 1972). See NMAB-308-1; CONF-7209117-P1.

Unidirectionally solidified Co-Co_3Nb eutectic samples of slightly differing compositions were subjected to long time annealing and thermal cycling treatments. The eutectic showed metallographic and crystallographic stability after vacuum annealing for periods up to 1000 hr at 1000°C. Structural stability was also observed during thermal cycling experiments conducted completely above the temperature of the cobalt fcc ⇌ hcp phase transformation. However, when the thermal cycle included the cobalt transformation temperature, samples containing 0.2 wt % nickel showed microstructural breakdown, whereas samples with 0.01 wt % nickel did not. In addition, the latter samples quickly developed and retained the fcc form of cobalt during cycling. It is believed that the higher nickel content influences the stacking fault structure and energy sufficiently so that the internal energy can overcome the barrier of the transformation. The results provide a mandate for thorough evaluation of eutectics whose phases undergo transformations within the projected temperature range of product use. (auth)

21776 INFLUENCE OF INTERLAMELLAR SPACING ON THE STRENGTH OF THE Ni_3Al-Ni_3Cb EUTECTIC. Thompson, E. R.; George, F. D.; Breinan, E. M. (United Aircraft Research Labs., East Hartford, CT). pp 71-82 of Conference on in situ Composites. Vol. II. Washington, DC; National Academy of Sciences (1973).

From conference on in situ composites; Lakeville, Connecticut, USA (5 Sep 1972). See NMAB-308-2; CONF-7209117-P2.

The $Ni_3Al(\gamma')$-$Ni_3Nb(\delta)$ eutectic composite, which consists of 44 volume percent of the δ intermetallic as a lamellar dispersion within γ′, has been previously identified as having outstanding tensile and creep properties when grown at a rate of 2 cm/h, thereby producing an interlamellar spacing of approximately 3.8 microns. The temperature dependence of the tensile properties was determined for this eutectic after directional solidification at rates between 0.5 and 10.6 cm/h. The cubic γ′ in the eutectic grows in the [110] and the orthorhombic δ in the [100]. The preferred slip plane of the δ phase is parallel to the growth direction and, in response to a longitudinal stress, deformation in the δ occurred initially by twinning. The lamellar spacing which decreased with increased solidification rate was found to affect the tensile strength of the eutectic according to a Hall-Petch correlation. By decreasing the spacing the strength was increased. The eutectic grown at 10.6 cm/h possessed a strength at 2000°F, as high as 142 ksi. Reduction of the lamellar spacing was also observed to increase the creep resistance of the eutectic composite. The activation energy for creep was found to be independent of the spacing and to be attributable to a diffusional process occurring in the Ni_3Nb intermetallic. (auth)

21777 ELEVATED TEMPERATURE TENSILE AND CREEP RUPTURE BEHAVIOR OF THE UNIDIRECTIONALLY SOLIDIFIED Ni-Ni_3Nb EUTECTIC COMPOSITE. Gangloff, R. P.; Hertzberg, R. W. (Lehigh Univ., Bethlehem, PA). pp 83-103 of Conference on in situ Composites. Vol. II. Washington, DC; National Academy of Sciences (1973).

From conference on in situ composites; Lakeville, Connecticut, USA (5 Sep 1972). See NMAB-308-2; CONF-7209117-P2.

The aligned Ni-Ni_3Nb eutectic composite was studied to characterize its hot tensile and creep rupture response between 25 and 1000°C. Three distinct deformation and fracture mechanisms were found to control the elevated temperature response of the composite. Region I deformation behavior, observed to operate in tension between 25 and 600°C and under short time 600°C stress rupture conditions, was characterized by Ni_3Nb (δ) phase twinning on K_1 planes of the type {211}δ, and by subsequent twin boundary cracking. Region I specimens fractured by the coalescence of sub-critical δ phase cracks. Region II behavior, revealed in 600 to 875°C tensile specimens, and in long time 600 and short time 750°C creep rupture specimens, was characterized by a cooperative twinning mechanism. δ-γ cooperative twinning resulted in two variants of transgranular bands composed of colinear γ and δ twins. It was hypothesized that specimens deformed in Region II failed prematurely due to the coalescence of long sub-critical cracks formed along such transgranular bands. Region III behavior, observed in 875 and 1000°C tensile specimens and after long time 750°C stress rupture exposure, was related to void nucleation at lamellae ends and eutectic grain boundaries, and subsequent void coalescence into large transgranular cracks. (auth)

21778 EUTECTIC SUPERALLOYS STRENGTHENED BY δ, Ni_3Cb LAMELLAE, AND γ′, Ni_3Al PRECIPITATES. Lemkey, F. D.; Thompson, E. R. (United Aircraft Research Labs., East Hartford, CT). pp 105-119 of Conference on in situ Composites. Vol. II. Washington, DC; National Academy of Sciences (1973).

From conference on in situ composites; Lakeville, Connecticut, USA (5 Sep 1972). See NMAB-308-2; CONF-7209117-P2.

Bivariant eutectic alloys, located on a liquidus surface within the Ni-Nb-Cr-Al quaternary, were identified which permitted the production of aligned δ Ni_3Nb lamellae within a nichrome matrix containing the fcc precipitate γ′, Ni_3Al. The volume fraction of δ and γ′ could be varied significantly by compositional changes. After directional solidification certain alloys possessed improved ductility and corrosion resistance with respect to the Ni_3Al-Ni_3Nb eutectic while their values of tensile and creep strength approached or exceeded those for the Ni_3Al-Ni_3Nb pseudobinary system. The mechanical properties of the directionally solidified alloy, Ni-19.7 wt % Nb-6.0 wt % Cr-2.5 wt % Al, were evaluated. Its longitudinal strength in tension and creep was found to be superior to all advanced nickel base superalloys. Results of this investigation demonstrated that useful properties for gas turbine airfoil applications have been achieved by reinforcing a strong and tough gamma nichrome matrix containing precipitated gamma prime by a lamellar intermetallic compound having greater strength at elevated temperature. (auth)

21779 DEFORMATION OF DUCTILE Ni-W EUTECTIC COMPOSITES. Garmong, G.; Williams, J. C. (North American Rockwell Science Center, Thousand Oaks, CA). pp 149-172 of Conference on in situ Composites. Vol. II. Washington, DC; National Academy of Sciences (1973).

From conference on in situ composites; Lakeville, Connecticut, USA (5 Sep 1972). See NMAB-308-2; CONF-7209117-P2.

The deformation of the Ni-45.5 wt % W eutectic directionally solidified at 3 cm per h has been studied for specimens in the as-quenched and as-quenched-plus-aged conditions. The tension stress-strain curve of the eutectic in the as-quenched condition exhibits the four classical stages of ductile composite deformation. The tungsten reinforcement phase elastically deforms to about 1.8% strain, or approximately 9×10^5 psi. Slip in the as-quenched material is primarily random, although some planar dislocation arrays due to the matrix short-range order are seen. Pileups against the fibers are relaxed by cross slip. Aging the as-quenched eutectic at 750 and 975°C results in marked improvements in strength. In specimens aged at 750°C precipitate shearing leads to a channeling of slip and higher stress concentrations on the fibers. As a result the fibers yield at lower strains. In specimens aged at 975°C the matrix precipitates are so large that dislocations bow around them, resulting once again in turbulent non-planar slip. However, the matrix strength is so high that the fibers yield at lower strains than in as-quenched material. To explain the observations it is postulated that localized matrix stresses can induce fiber yielding, whether the stresses are produced by local work hardening, slip-band stress concentrations, or a generally high level of matrix strength. (auth)

21780 MICROSTRUCTURE AND STRENGTH PROPERTIES OF Co-$NbCo_3$ EUTECTIC ALLOY PRODUCED BY UNIDIREC-

TIONAL SOLIDIFICATION AT DIFFERENT GROWTH RATES. Gudas, J. P. (Naval Ship Research and Development Center, Annapolis, MD); van Reuth, E. C.; Armstrong, R. W. pp 251-260 of Conference on in situ Composites. Vol. II. Washington, DC; National Academy of Sciences (1973).

From conference on in situ composites; Lakeville, Connecticut, USA (5 Sep 1972). See NMAB-308-2; CONF-7209117-P2.

The eutectic alloy Co–$NbCo_3$ has been unidirectionally solidified at rates from 1.28 to 17.6 microns/s. A well-defined lamellar microstructure resulted for solidification rates below 3.17 microns/s, while a mixed dendritic–lamellar structure was obtained above this rate. Results of compression test established that both types of microstructure are essentially brittle at room temperature. Results of these tests and hardness tests demonstrated that an increased strengthening occurred with increased solidification rate for each type of microstructure. It appears that constrained slip within the relatively ductile Co phase causes a pronounced dependence of the in situ composite strength on interphase spacing. The resultant stress concentrations lead to crack formation at interphase boundaries or within the relatively brittle $NbCo_3$ phase. (auth)

21781 OBSERVATIONS ON THE GROWTH AND TENSILE PROPERTIES OF Ni-RICH AND Ni–Al–Nb EUTECTIC ALLOYS. Kraft, E. H.; Thompson, E. R. (United Aircraft Research Labs., East Hartford, CT). pp 261-271 of Conference on in situ Composites. Vol. II. Washington, DC; National Academy of Sciences (1973).

From conference on in situ composites; Lakeville, Connecticut, USA (5 Sep 1972). See NMAB-308-2; CONF-7209117-P2.

The growth characteristics and resultant properties of directionally solidified composite alloys based on the eutectics Ni_3Al–Ni_3Nb and Ni–Ni_3Al–Ni_3Nb have been examined. Hypoeutectic alloys of the pseudo-binary eutectic exhibit increased ductility if the structure is produced with a low fault density. Ternary alloys can be grown at much higher solidification rates than the pseudo-binary eutectic, provided the composition is adjusted. These alloys also have greater ductility and the promise of greater transverse toughness than the pseudo-binary alloy, although high temperature strength is somewhat lower. (auth)

21782 HIGH TEMPERATURE PROPERTIES OF THE UNIDIRECTIONALLY SOLIDIFIED Ni_3Al–Ni_3Ta EUTECTIC. Hubert, J. C.; Mollard, F. R.; Lux, B. (Battelle Geneva Research Center). pp 323-331 of Conference on in situ Composites. Vol. II. Washington, DC; National Academy of Sciences (1973).

From conference on in situ composites; Lakeville, Connecticut, USA (5 Sep 1972). See NMAB-308-2; CONF-7209117-P2.

The unidirectionally solidified Ni_3Al–Ni_3Ta eutectic was found to exhibit high temperature mechanical properties which represent a substantial improvement over conventional nickel-base superalloys. Stress rupture and minimum creep rate data to 1000°C and short-time tensile properties to 1200°C were determined. These properties, measured in the direction of alignment, were found to be superior to those of the cast superalloy IN-100. The favorable high temperature behavior of this eutectic composite, which contains a high volume fraction of fibers, was found to be related to the excellent bond between fibers and matrix, and the effectiveness of the ductile fibers in preventing crack propagation through the brittle matrix. (auth)

21783 COMPUTER CALCULATION OF THE CHROMIUM–COLUMBIUM–NICKEL SYSTEM. Kaufman, L.; Nesor, H. (ManLabs, Inc., Cambridge, MA). pp 21-32 of Conference on in situ Composites. Vol. III. Washington, DC; National Academy of Sciences (1973).

From conference on in situ composites; Lakeville, Connecticut, USA (5 Sep 1972). See NMAB-308-3; CONF-7209117-P3.

Computer techniques were employed to describe the Cr–Nb–Ni ternary system and its component binaries to provide an explicit description of the thermochemical and constitutional characteristics. This description yields complete isothermal sections and liquidus projections which compare favorably with observations. (auth)

21784 THERMOCHEMICAL CONSIDERATIONS OF HIGH TEMPERATURE GAS–SOLID REACTIONS. Jansson, S. A.; Gulbransen, E. A. (Westinghouse Research Labs., Pittsburgh). pp 2-32 of High Temperature Gas–Metal Reactions in Mixed Environments. Jansson, S. A. (Ed.). New York; Metallurgical Society of the American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc. (1973).

From 4th annual spring meeting of the metallurgical society of AIME; Boston, Massachusetts, USA (8 May 1972). See CONF-720515-.

Thermochemical analyses and diagrams are of value for studying the importance of different chemical processes in complex reaction systems. This paper treats the Si–O–N, Cr–O–N, Na–O–S, Cr–O–S, Al–O–S, Na–Cr–O–S, Na–Al–O–S, and Ta–O–C, systems. There is a need for reexamining the phase relations in the Si–O–N system preferably under conditions where volatile species cannot form, and to determine the volatility of ternary Si–O–N species. Na_2CrO_4 and $NaAlO_2$ can form by reaction of Cr_2O_3 and Al_2O_3 with $NaSO_4$ under locally reducing conditions. Such reactions are one probable cause for the destruction of protective oxide scales in gas turbine alloys in the presence of contaminant deposits, inducing "hot corrosion" attack. The reactions of Ta(s) and TaC(s) in oxidizing, carburizing and oxidizing/carburizing environments involve the formation of TaO(g), TaO_2(g), and CO(g) species. TaC(s) is unstable in vacuum and in inert gas, but can be stabilized in CO(g) and other carbon-containing gases. (16 figures, 22 references) (auth)

21785 CALCULATION OF SUPERALLOY PHASE DIAGRAMS. II. Kaufman, L.; Nesor, H. (Man Labs., Inc., Cambridge, MA). Met. Trans.; 5: No. 7, 1623-1629(Jul 1974).

Explicit descriptions of the Mo–Al, Fe–Al, and Ni–Al systems were developed and combined with descriptions of seven binary systems developed previously to compute significant numbers of isothermal sections in the Mo–Al–Cr, Ni–Al–Fe, Cr–Ni–Al, Al–Ni–Mo, and Ni–Al–Ti systems. Comparison of these calculations with limited experimental data yields good results and provides considerable insight into the stability of the bcc phase in these systems. The computations provide detailed information on tie-line configurations and melting minima in these systems. (9 fig, 8 tables) (auth)

21786 BRAGG–WILLIAMS AND OTHER MODELS OF THE OMEGA PHASE TRANSFORMATION. de Fontaine, D. (Univ. of California, Los Angeles); Kikuchi, R. Acta Met.; 22: No. 9, 1139-1146(Sep 1974).

Various previously proposed models of the $\beta \rightarrow \omega$ phase transformation in Ti, Zr, Hf alloys are briefly reviewed. A new Bragg–Williams model of the displacive order–disorder transition is introduced in the single-variant approximation. A closed-form free energy expression is derived which exhibits typical first-order characteristics. A prediction is made for the temperature dependence of the long-range order parameter. This parameter measures the degree of advancement of (111)-plane collapse or, equivalently, the amplitude of the $\frac{1}{3}[111]$ ω-wave. (auth)

21787 PRECIPITATION OF CARBIDES IN DEFORMED VANADIUM. Chang, H. Y. (Gillette Labs., Boston); Wert, C. A. Met. Trans.; 5: No. 7, 1671-1676(Jul 1974).

Strain aging measurements on alloys of vanadium with 0.3 at. % carbon were carried out at 200 to 500°C. The multiplicity of hardening stages characteristic of aging in this alloy is not altered by deformation. This behavior is interpreted as evidence that carbides nucleate in such profusion through the bulk of the metal that dislocations do not contribute an appreciable fraction of additional nucleation sites (even after 40 % deformation). Only in the final stages of hardening does deformation influence the kinetics of the process. (8 fig, 45 references) (auth)

21788 Gd–Yb AND Lu–Yb PHASE SYSTEMS. Beaudry, B. J.; Spedding, F. H. (Ames Lab., IA). Met. Trans.; 5: No. 7, 1631-1636(Jul 1974).

The Gd–Yb and Lu–Yb phase systems were established by thermal analysis, x-ray diffraction, metallography, electron microprobe, and chemical analyses. The solubility of Yb in α-Gd ranges from 6.5 at. % at 500°C to 19.0 at. % at 1161°C. The addition of Yb to Gd lowers the β (bcc) to α (hcp) transformation temperature to an inverse peritectic reaction at 20.0 at. % Yb and 1161°C. The addition of Yb to Gd lowers the mp of Gd to a monotectic horizontal at 1183°C which extends from 21.0 to 71.0 at. % Yb. The monotectic composition is 49.0 at.% Yb. The solid solubility of Gd in Yb ranges from 0.2 at.% at 500°C to 2.3 at. % at 819°C. The mp of Yb is raised from 816 to 819°C by the addition of Gd while the γ (bcc) to β (fcc) transformation temperature of Yb is lowered from 796 to 780°C by the addition of Gd. The solubility of Yb in solid Lu ranges from 6.0 at. % at 800°C to 15 at. % at 1530°C. The addition of Yb to Lu lowers the mp of Lu to a monotectic horizontal at 1530°C which extends from 15 to 90 at. % Yb. The monotectic composition is approximately 30 at. % Yb. The solid solubility of Lu in Yb ranges from less than 0.1 at. % at 500°C to 0.3 at. % at 817°C. The addition of Lu raises the melting point of Yb to 817°C and also raises the β (fcc) to γ (bcc) transformation temperature to 798°C. (6 fig) (auth)

21789 CALCULATION OF SUPERALLOY PHASE DIAGRAMS. I. Kaufman, L.; Nesor, H. (Man Labs., Inc., Cambridge, Ma). Met. Trans.; 5: No. 7, 1617-1621(Jul 1974).

Previously defined, explicit thermochemical formulations of the lattice stability, solution and compound parameters for twelve binary systems were employed to compute significant numbers

of isothermal sections in the ternary systems Cr–Ni–Fe, Co–Fe–Ni, Co–Cr–Fe, Co–Cr–Ni, Ni–Cr–Mo, Ni–Cb–Mo, and Ni–Ti–Cr. Results provide sufficient definition to locate lines of two-fold saturation, eutectic troughs, and minima and complete liquidus projections in addition to providing complete thermochemical descriptions of the systems in question. Comparison of the calculated isothermal sections with the limited experimental results available yields good agreement. (9 fig) (auth)

21790 EFFECT OF NORMAL STRESS ON YIELD ASYMMETRY IN HIGH PURITY TANTALUM CRYSTALS. Webb, G. L.; Gibala, R.; Mitchell, T. E. (Case Western Reserve Univ., Cleveland). Met. Trans.; 5: No. 7, 1581-1584(Jul 1974).

Resolved yield stresses were determined in tension and compression for ultrahigh vacuum degassed tantalum crystals as a function of orientation at 77 and 197°K. The yield stress at 77°K was a minimum for specimens oriented to slip on the $(\bar{1}12)$ $[1\bar{1}1]$ system, and a maximum for specimens oriented to slip on the $(\bar{1}12)$ $[1\bar{1}1]$ system. The yield stress in tension was less than the yield stress in compression for all orientations. However, at 197°K, the yield stress in tension was found to be greater than in compression for specimens oriented to slip on the (121) $[1\bar{1}1]$ system in agreement with Lachenmann and Schultz, who also found that, for specimens oriented to slip on the $(\bar{1}12)$ $[1\bar{1}1]$ system, the yield stress in compression was higher than the yield stress in tension, as occurs at 77°K. This behavior may be explained by the influence of a normal stress on a lattice expansion which occurs when the leading {112} stacking fault of a dissociated core dislocation as described by Duesbery et al. begins to move. (auth)

21791 NORMAL SPECTRAL EMITTANCE OF VANADIUM AND TANTALUM FOR DIFFERENT SURFACE CONDITIONS AT TEMPERATURES ABOVE 1000 K. Baria, D. N.; Bautista, R. G. (Ames Lab., IA). Met. Trans.; 5: No. 7, 1543-1546(Jul 1974).

The normal spectral emittance ($\lambda = 0.645\mu$) was determined for vanadium between 1100 and 1750°K and for tantalum between 1200 and 2600°K, at pressures below 10^{-6} mm Hg for electrochemically and mechanically polished surfaces. The emittance was found to decrease with increase in temperature. It was also lower for the electrochemically polished surface. An empirical equation was fitted to the experimental data, and it was used to predict the emittances up to the melting points. (5 figures, 23 references) (auth)

21792 EFFECTS OF Mo AND W ON SOLIDIFICATION OF HIGH SPEED STEELS. Galda, E. J. (Air Force, Davis-Monthan, AFB, AZ); Kraft, R. W. Met. Trans.; 5: No. 8, 1727-1733(Aug 1974).

The effects of systematic variations in Mo content, W content, and the Mo:W ratio upon the freezing process and as-cast carbide morphology of high-speed steels were studied for four series of alloys encompassing the nominal composition ranges of AISI type M2 (6 W–5 Mo–4 Cr–2 V–0.85 C) and M10 (0 W–8 Mo–4 Cr–2 V–0.85 C) high-speed steels. Thermal analysis, metallographic examination, and quantitative metallography were used to characterize these effects. The liquidus, peritectic, and eutectic reactions were similarly influenced by Mo and W, the peritectic temperature being strongly depressed by additions of either element. The types of carbides found in the as-cast structures did not vary, but the amount of feathery eutectic carbide (a layered structure of MC and M_6C) was directly related to the total Mo plus W content. The amount of isolated vanadium-rich MC type carbide was seen to increase as the amount of feathery eutectic decreased, and also varied with the Mo:W ratio. (11 figures) (auth)

21793 MECHANISM OF FATIGUE FAILURE. Kramer, I. R. (Martin Marietta Aerospace, Denver). Met. Trans.; 5: No. 8, 1735-1742(Aug 1974).

It was shown that when specimens of 2014-T6 aluminum, titanium (6 Al–4 V), and 4130 steel were fatigued, the strength of the surface layer increased. When the strength of this layer reached a critical value, independent of the cyclic stress amplitude a fatigue crack was initiated. The increase in the fatigue life by periodically removing the outer layer of a specimen was investigated under conditions where persistent slip bands or cracks were not present. Results indicate that the increase in fatigue life is associated with a decreased strength of the surface layer resulting from the removal of the high density dislocation layer at the surface. (10 figures, 57 references) (auth)

21794 THEORY OF HIGH TEMPERATURE INTERCRYSTALLINE FRACTURE UNDER STATIC OR FATIGUE LOADS, WITH OR WITHOUT IRRADIATION DAMAGE. Weertman, J. (Los Alamos Scientific Lab., NM). Met. Trans.; 5: No. 8, 1743-1751(Aug 1974).

Hull and Rimmer's theory of high-temperature creep fracture by grain boundary void growth and Skelton's theory of high-temperature fatigue fracture are extended. The present theory includes the effect on void growth of volume diffusion and of vacancy generation by irradiation damage or plastic deformation within the grain interiors. The growth rate of cylindrical as well as spherical voids is calculated. It is found that the presence of volume diffusion or of vacancy generation within the grain does not increase very much the growth rate of spherical voids but under certain conditions the growth rate of cylindrical voids is increased markedly. Unlike Skelton, it is found that vacancy production within the grains does not decrease the critical radius for the growth of a grain boundary void in push-pull fatigue. (Likewise intragranular vacancy production does not decrease the critical radius of grain boundary voids in creep.) Since in push-pull fatigue void growth is observed in the case of radii smaller than the critical value it is concluded that the stress concentrations that are produced by grain boundary sliding (according to the theory of Raj, Ashby, and Gifkins) are responsible for this growth. Whether voids aided by stress concentrations can continue to grow beyond a certain size depends critically upon the "roughness" of the grain boundary. It is recommended that grain boundary internal friction peak studies be carried out in connection with void growth and high temperature fracture experiments. Grain boundary voids are more likely to grow in push-pull fatigue (or in creep) if the value of the grain boundary sliding activation energy is close to that of volume self diffusion rather than if the sliding activation energy is close to the grain boundary self diffusion activation energy. (auth)

21795 CORRELATIONS BETWEEN FRACTURE SURFACE APPEARANCE AND FRACTURE MECHANICS PARAMETERS FOR STAGE II FATIGUE CRACK PROPAGATION IN Ti–6Al–4V. Yuen, A.; Hopkins, S. W.; Leverant, G. R.; Rau, C. A. (Prat and Whitney Aircraft, Middletown, CT). Met. Trans.; 5: No. 8, 1833-1842(Aug 1974).

Stage II fatigue crack propagation in Ti–6Al–4V was studied as a function of various fracture mechanics parameters, including the stress intensity range (ΔK) and both positive and negative ratios of the minimum to maximum stress (R). It was found that the fracture surface appearance undergoes a transition from cyclic cleavage to striations at a ΔK_{eff} of approximately 13 $MNm^{-3/2}$ (11.8 ksi $\sqrt{in.}$). It was also observed that the measured striation spacings are generally within a factor of two of the optically measured crack growth rates. Both of these results can be particularly useful for determining unknown component cyclic loadings during failure analysis. The criterion for the cyclic cleavage to striation transition is considered to be a change from primarily single to multiple slip within the individual grains at the crack tip. This occurs when the cyclic plastic zone size becomes approximately equal to the α grain size. (auth)

21796 HYDROGEN COMPATIBILITY OF DISPERSION-STRENGTHENED ALLOYS. Thompson, A. W. (Rockwell International, Thousand Oaks, CA). Met. Trans.; 5: No. 8, 1855-1861(Aug 1974).

Hydrogen compatibility of Ni–2 ThO_2, Ni–20 Cr, Ni–20 Cr–2 ThO_2, and Inconel MA 753 was investigated with both hydrogen charging and tests in high-pressure hydrogen gas. The former were conducted at 194°K as well as at room temperature. Ductility and fractography results showed that recrystallized Ni–20 Cr–2 ThO_2 and MA 753 were not embrittled by hydrogen, while Ni–2 ThO_2 showed small ductility losses with no change in fracture morphology. Annealed Ni–20 Cr–2 ThO_2 and as-received Ni–20 Cr–2 ThO_2 showed no ductility losses in charged hydrogen, but showed large ductility losses in high-pressure hydrogen; no changes in fracture morphology were observed. Ni–20 Cr was markedly embrittled by both sources of hydrogen. Results support the hypothesis of Thompson and Wilcox, that the presence of a dispersoid can confer improved performance in hydrogen. (auth)

21797 AGING BEHAVIOR OF ORTHORHOMBIC MARTENSITE IN Ti–6–2–4–6. Young, M.; Levine, E.; Margolin, H. (Polytechnic Inst. of New York, Brooklyn). Met. Trans.; 5: No. 8, 1891-1898(Aug 1974).

In Ti–6Al–2Sn–4Zr–6Mo alloys, beta transforms to orthorhombic martensite when quenched from a temperature of 1188 K or above, X-ray analysis showed that aging at 773 or 873°K gradually reduces the degree of orthorhombicity until a hexagonal structure equivalent to alpha, but having the morphological characteristics of the prior martensite, is produced. The orthorhombicity is reduced by solute rejection to beta which forms as particles both homogeneously and heterogeneously within the martensitic structure. The structure at maximum hardness is a fine distribution of Burger's oriented beta particles in a matrix of martensite of greatly reduced orthorhombicity. Over-

aging appears to occur as a result of coarsening of the homogeneous beta particles. It is shown that aging at temperatures from 873 to 1083°K results in growth of one particular varient of the beta which is located at the interface between twin related regions composing a martensite lath. This beta along with similarly oriented beta at lath interfaces forms a continuous beta matrix by a gradual growth process. It is shown that this matrix has the identical orientation and shape of the original beta grain prior to quenching. A mechanism is proposed to account for this "memory effect." (auth)

21798 AGE-HARDENING IN THE V–C AND Nb–C SYSTEMS. Chang, H. Y. (Gillette Labs., Boston); Viswanadham, R. K.; Wert, C. A. Met. Trans.; 5: No. 8, 1907-1917(Aug 1974).

Age hardening measurements were carried out for alloys of vanadium and niobium containing 0.3 at. % carbon. For both systems, four distinct stages of hardening are observed as a function of time. For all stages, carbon diffusion in the metal is the rate controlling factor. The process is thought to involve formation of a sequence of subcarbides prior to formation of the stable V_2C or Nb_2C, according to the following scheme: solid solution → carbon-rich zones → series of subcarbides → Me_2C (hexagonal). Overaging occurs as the final coherent subcarbide begins to transform into the stable hexagonal phase with attendant loss of lattice coherency. (20 figures) (auth)

21799 EMBRITTLEMENT OF Ti–6Al–2Sn–4Zr–2Mo alloy by α_2-PHASE PRECIPITATION. Mendiratta, M. G. (Systems Research Labs., Inc., Dayton, OH); Chakrabarti, A. K.; Roberson, J. A. Met. Trans.; 5: No. 8, 1949-1951(Aug 1974).

A correlation is made between the RT tensile properties and fracture toughness of the Ti-6242 alloy and the presence of the α_2-phase precipitates. The increased yield strength in the aged condition is attributed to the resistance which the coherent, ordered α_2 particles offer to the glide dislocations. The α_2 particles are very small and are likely to be sheared by the dislocations, leading to the formation of highly planar, heterogeneous slip and thus embrittlement. (DLC)

21800 EFFECTS OF SMALL AMOUNTS OF ADDED OXYGEN AND NITROGEN ON THE TEMPERATURE DEPENDENCES OF THE MECHANICAL PROPERTIES OF NIOBIUM. Amonenko, V. M.; Azhazha, V. M.; Zeidlits, M. P.; Shevchenko, S. V. (Physical-Technical Inst., Kharkov). Strength Mater. (USSR) (Engl. Transl.); 5: No. 6, 699-701(Jun 1973).

Translated from Probl. Pronchnosti; 5: No. 6, 54-56(Jun 1973).

Niobium with a purity of 99.8 wt %, in which the main metallic impurities were 0.09% Ta, 5×10^{-3} wt % W, and 5×10^{-3} wt % Fe was used. The contents of interstitial impurities in wt % were as follows, H_2, 2×10^{-3}; O_2, 5×10^{-3}; and N_2, 2.6×10^{-3}. Mechanical tests were made on specimens of sheet niobium with a working section 22 mm long and 5×0.5 mm^2 in cross section. The mechanical properties of the specimens were determined under tension at 1.6×10^{-3} s^{-1} in a vacuum of 5×10^{-5} mm. The specimens were first heated to a given temperature in a low-inertia resistance furnace. Results of the investigations show that the maxima on the temperature dependences of the yield points and strengths and the corresponding minima of the plasticity of niobium in the range from 250 to 350°C are due to interaction of moving dislocations with dissolved oxygen, while in the range from 500 to 500°C they are due to dissolved nitrogen. (JRD)

21801 BRITTLENESS OF COATED TUNGSTEN WIRE. Levinskii, Yu. V.; Trefilov, B. F.; Dvoichenkova, L. V. (All-Union Inst. of Aviation Materials, Moscow). Strength Mater. (USSR) (Engl. Transl.); 5: No. 6, 702-705(Jun 1973).

Translated from Probl. Prochnosti; 5: No. 6, 57-59(Jun 1973).

The effect on the fracture behavior of tungsten wire of the nature and thickness of brittle layers grown specially on its surface were studied. The starting materials were tungsten wire of grades VA and VRN 300 and 500 μ in diameter, respectively. Brittle surface layers of varying thickness were created on the wire either by forming a brittle surface zone of recrystallized grains or by carbidization. As previously observed, when tungsten is brought into contact with nickel at high temperatures, a brittle recrystallized zone develops on the surface of the tungsten. This effect was used to obtain brittle layers on tungsten wire, some of which was vacuum-annealed in nickel vapor, while some was hot-pressed into electrolytic nickel powder. The compact specimens obtained were vacuum-annealed for various periods at a temperature of 1100 to 1200°C. Depending on the temperature and annealing time recrystallized surface layers of different thickness were produced on the wire. After annealing the wire was extracted by dissolving away the nickel in a boiling solution of hydrochloric acid (1 : 4). It was experimentally confirmed that boiling in hydrochloric acid has no effect on the properties of the wire. Carbide layers on the surface of the wire were similarly obtained except that instead of electrolytic metal powder carbonyl nickel powder was used. During the annealing of the specimens the carbon in the carbonyl nickel reacted with the tungsten to form carbide layers on the surface of the latter. Two-layer coatings (tungsten + carbide, tungsten + nickel) were obtained by incompletely removing the nickel from specimens with a layer of tungsten carbide. Results are presented in graphs and discussed. (JRD)

21802 EFFECT OF ALLOYING WITH ELEMENTS OF GROUP VIII ON THE MECHANICAL PROPERTIES OF A MOLYBDENUM–CARBON ALLOY IN THE CASE AND RECRYSTALLIZED STATES. Shchukin, A. A.; Mal'tsev, M. V.; Biryukova, T. A. (All-Union Scientific Research Inst. of Hard Alloys, Moscow). Strength Mater. (USSR) (Engl. Transl.); 5: No. 6, 746-749(Jun 1973).

Translated from Probl. Prochnosti; 5: No. 6, 96-99(Jun 1973).

The effects of iron, cobalt, nickel, and iridium on the properties of molybdenum containing 0.05 to 0.10% carbon were studied. The mechanical properties of the molybdenum were determined on specimens of sheet 1 mm thick and rods 8 mm in diameter produced from ingots cast from an electron-beam melt. Tensile tests on the semifabricated products were carried out at room temperature with a deformation rate of 2.5×10^{-3} s^{-1}. It was found that the ductility of recrystallized Mo–C alloys can be increased by microalloying with elements of group VIII. It is noted that when free forging was replaced by extrusion, rods of good quality were obtained from the alloy containing 0.09% Ni and these could be further reduced to 9 mm diameter without any difficulty. The variation in the mechanical properties of the Mo–0.09% C–0.09% Ni alloy in tension under room-temperature conditions as a function of the annealing temperature is shown graphically. This alloy retains satisfactory ductility even after being annealed at 1700°C for 1 h. (JRD)

21803 RETARDATION OF THE RECRYSTALLIZATION OF TUNGSTEN WIRE IN Ni AND NiCr-MATRIX. Gruenling, H.; Hofer, G. (Kraftwerk Union AG, Erlangen, Ger.). Werkstatttechnik; 5: No. 2, 69-72(Mar 1974). (In German).

From conference on composite materials; Konstanz, Germany (28 Mar 1974).

Nickel and other metals are known to reduce the recrystallization temperature of doped tungsten and tungsten–2% thorium oxide. This effect and its retardation were investigated within the framework of a more comprehensive study of fiber-reinforced materials. (auth)

21804 ANISOTROPY OF LOW-TEMPERATURE PLASTICITY AND TENDENCY TOWARD SCALING OF DEFORMED MOLYBDENUM. Ivashchenko, R. K.; Mil'man, Yu. V.; Trefilov, V. I.; Khomenko, G. E. (Inst. of Metal Physics, Kiev). Strength Mater. (USSR) (Engl. Transl.); 5: No. 7, 839-842(Jul 1973).

Translated from Probl. Prochnosti; 5: No. 7, 64-67(Jul 1973).

A microdiffraction method was used to study the texture of Mo rolled at various temperatures. These studies were conducted to relate scaling tendencies and low temperature plasticity of Mo with rolling temperature. Comparison of the tendency to scale of molybdenum rolled at different temperatures with the changes in a number of structural and substructural characteristics confirms the theory that scaling in large measure is due to formation of a striated cellular structure during deformation (with the cell boundaries having a high stress level parallel to the rolling plane) and the ease in which brittle cracks develop along such boundaries. Accumulation of microdefects during deformation is the cause of scaling; the defects are strongly stressed dislocation subboundaries elongated in the rolling direction. A number of factors such as the presence of dispersed insoluble-phase particles, a definite crystallographic texture, weak grain boundaries, and impurity segregation at the grain and cell boundaries can intensify the tendency of a deformed metal to scale. However, there is no clear correlation between these factors and the tendency of molybdenum deformed at different temperatures to scale. (JRD)

21805 PROPERTIES OF LOW-PEARLITIC STEELS WITH VANADIUM AND NIOBIUM AFTER CONTROLLED ROLLING. Matrosov, Yu. I.; Nazibov, A. G.; Golikov, N. Metal Sci. Heat Treat. (USSR) (Engl. Transl.); 16: No. 1-2, 28-34(1974).

Translated from Metalloved. Term. Obrab. Metal; 16: No. 1, 27-34(Jan 1974).

The effects of rolling conditions on the strength, plastic characteristics, and resistance to fracture of these steels were investigated. It was found that raising the initial rolling temperature from 1050-1100 to 1200-1250°C increases the strength characteristics due to the solution of carbonitrides; therefore, the effect of the increase in strength is stronger in the steel alloyed with vanadium and niobium, and is hardly manifest in the steel not containing these elements. Lowering the final rolling temperature from 950 to 700°C leads to higher strength characteristics, particularly final rolling at 700°C. Lowering the final rolling temperature lowers the ductile-brittle transition temperature (T_{50}), i.e., increases the resistance to brittle

fracture. However, the work of crack propagation decreases in this case, i.e., the resistance to ductile fracture. The increase in strength and lower ductile-brittle transition temperature when the final rolling temperature is lowered are due to grain refining. However, the work of crack propagation decreases in this case (a_p) and also the notch toughness at −40°C. A final rolling temperature of 800°C produces the best combination of mechanical properties. The high values of the strength, ductility, and toughness in combination with a very low carbon equivalent are the basis for considering low-pearlitic steels as promising materials for welded structures and materials requiring good weldability and resistance to fracture. Controlled rolling makes it possible to control the properties of these steels within wide limits by changes in the strength, ductility, and toughness, depending on the requirements. (auth)

21806 SUSCEPTIBILITY TO BRITTLE FRACTURE OF LOW-ALLOY STEELS WITH ADDITIONS OF NIOBIUM, VANADIUM, AND NITROGEN. Pridantsev, M. V.; Kochin, F. I.; Fetisov, S. G.; Pavlenko, N. T. Metal Sci. Heat Treat. (USSR) (Engl. Transl.); 16: No. 1-2, 35-37(1974).

Translated from Metalloved. Term. Obrab. Metal; 16: No. 1, 34-38(Jan 1974).

The effects of small niobium and vanadium additions with nitrogen on the susceptibility to brittle fracture of low-alloy steel with a ferritic-pearlitic structure were studied. The steels, designated 15 GAF and 15 GB, were melted in 60-ton basic open hearth furnaces. The ingots were rolled to plates 12 and 60 mm thick and normalized at 880°C. It was found that since the work of crack propagation for steel 15GAF is not inferior to that of 15GB, and the work of crack initiation exceeds that of 15GB, preference should be given to steel 15GAF. Comparison of two or more steels in terms of susceptibility to brittle fracture cannot be limited to the type of fracture alone. To determine the reliability, the components of the impact strength must be determined or, which is adequate in practice under plant conditions, determine the impact strength a_n on samples with a V notch, when the value is close to the work of crack propagation. (auth)

21807 IMPACT STRENGTH AND COLD BRITTLENESS OF MOLYBDENUM ALLOY TsM-5. Malkhasyan, N. M. Metal Sci. Heat Treat. (USSR) (Engl. Transl.); 16: No. 1-2, 67-68(1974).

Translated from Metalloved. Term. Obrab. Metal; 16: No. 1, 63-64(Jan 1974).

The effects of heat treatment on the impact strength and ductile-brittle transition temperature of bars of alloy TsM-5 (0.57% Zr, 0.05% C, the remainder Mo) were studied. Bars mm in diameter were prepared from ingots obtained by vacuum remelting. Data and information concerning the structure and properties of TSM-5 are presented in diagrams, tables, and micrographs and discussed. (JRD)

21808 PROPERTIES OF HIGH-SPEED AND DIE STEELS AFTER TEMPERING AT LOW TEMPERATURE. Geller, Yu. A.; Aleksandrovich, B. L.; Andzhyus, P. A.; Golubeva, E. S.; Kremnev, L. S.; Sagadeeva, T. G. Metal Sci. Heat Treat. (USSR) (Engl. Transl.); 16: No. 1-2, 95-97(1974).

Translated from Metalloved. Term. Obrab. Metal; 16: No. 2, 2-4(Feb 1974).

The effects of tempering at 350 and 530°C on the properties of high-speed die steels were investigated. It was found that tempering at 350°C has some effect on the properties of more highly alloyed die steels with high heat resistance. These steels are hardened during tempering due to precipitation of M_6C carbides, i.e., similar to that occurring in high-speed steels. These steels were quenched from 1200 and 1180°C respectively (retaining a grain size of grade 10) and then tempered. Results of the tests showed that preliminary tempering at 350°C leads to an increase of hardness and heat resistance after final tempering. The ultimate and yield strengths and impact strength do not change significantly. The physical properties remain almost unchanged. The formation of cementite during tempering at 350°C has a favorable effect on subsequent precipitation of tungsten (molybdenum) carbide, but does not affect the precipitation of $M_{23}C_6$ carbide. The results make it possible to determine the effect of lowering the first tempering temperature and the range of application. Lowering the first tempering temperature is effective for high-speed and die steels in which the hardening phase is M_6C carbide. For the first tempering 350°C is recommended with prolonged heating and 530°C with brief heating. (auth)

21809 STRUCTURE AND PROPERTIES OF DIE STEELS OF THE 5Kh2MF TYPE. Tishaev, S. I.; Konrad, Yu. G.; Poznyak, L. A. Metal Sci. Heat Treat. (USSR) (Engl. Transl.); 16: No. 1-2, 98-100(1974).

Translated from Metalloved. Term. Obrab. Metal; 16: No. 2, 5-7(Feb 1974).

The optimum composition of 4Kh5MFS, 4Kh5V2FS, 5KhNM, and 5KhNV steels was investigated. It was found that the high heat resistance of die steels in combination with good strength ($\sigma_{0.2}$ = 135 to 140 kg/mm²) and toughness (a_n = 4 to 5 kg-m/cm²) through the section of large forgings (500 × 500 mm) after heat treatment is ensured by combined alloying within the following limits: 0.4 to 0.5% C, 0.5 to 1.0% Mn, 0.2 to 0.5% Si, 1.5 to 2.0% Cr, 0.8 to 1.2% Mo, 1.5 to 2.5% Ni, and 0.3 to 0.5% V. In its combination of basic properties (heat resistance, strength, and toughness of large forgings), steel of the 5Kh2N2MF type surpasses standard steels 5KhNM (5KhNV) and 4Kh5V2FS (4Kh5MFS), and can be recommended for large heavily loaded drop-forging and pressing dies for hot working. The partial transformation of austenite in steels of the 5Kh2MF type in the intermediate range during continuous cooling is accompanied by substantial reduction of the secondary hardness and toughness, and the highest secondary hardening occurs at 580 to 600°C. (auth)

21810 LONG-TERM STRENGTH OF MOLYBDENUM ALLOYS DURING CYCLIC HEATING. Goronkova, A. D.; Morgunova, N. N. Metal Sci. Heat Treat. (USSR) (Engl. Transl.); 16: No. 1-2, 112-115(1974).

Translated from Metalloved. Term. Obrab. Metal; 16: No. 2, 18-22(Feb 1974).

The effects of temperature and holding time in thermal cycles on the long-term strength of TSM-2A and TSM-3 Mo alloys were investigated. Results show that the long-term strength of molybdenum alloys subjected to cyclic changes of temperature is considerably lower than the long-term strength at constant temperature. The long-term strength of each alloy decreases in a certain temperature range if the holding time at the maximum temperature of the cycle is shorter than some critical time. The temperature range in which the long-term strength declines is 1500 to 2300°C for TsM-2A and 1000 to 1900°C for TsM-3. The critical holding time at the maximum temperature of the cycle is 50 s for both alloys. Only at temperatures that are characterized by the largest reduction of the long-term strength (1700 to 1750°C for TsM-2A and 1250°C for TsM-3) is the critical holding time over 50 s. Reducing the holding time at these temperatures leads also to a sharp reduction of the long-term strength during thermal cycling. It can be considered that for alloys of the solid solution type (TsM-2A) the drop of the long-term strength depends mainly on the cyclic thermal stresses that occur in rapid heating and cooling and the stress relaxation conditions. The long-term strength of the two-phase alloy hardened with carbides (TsM-3) may be substantially affected by internal stresses of structural origin that occur during thermal cycling and lead to larger thermal cycling effects. (auth)

21811 EFFECT OF AGING ON THE TEMPERATURE DEPENDENCE OF THE MECHANICAL PROPERTIES OF Mo−C−Zr ALLOYS. Kazakova, N. I.; Morgunova, N. N.; Kantor, M. M. Metal Sci. Heat Treat. (USSR) (Engl. Transl.); 16: No. 1-2, 116-121(1974).

Translated from Metalloved. Term. Obrab. Metal; 16: No. 2, 22-28(Feb 1974).

The temperature dependence of the mechanical properties is correlated with structural transformations that occur during high-temperature testing. The extreme properties (highest strength, lowest ductility, and lowest resistivity) depend on aging processes (precipitation hardening). Precipitation hardening occurs in Mo−C alloys when elements of group IVA are added, particularly zirconium, the effect increasing with the extent of alloying with zirconium and carbon (in the stoichiometric ratio of ZrC−1:1). Precipitation hardening is greatest for alloy TsM-5 in the quenched (recrystallized) condition at 1400°C (σ_b = 47 kg/mm²), and is lacking in the wrought condition. Heat treatment (aging) before the tests of Mo−C−Zr alloys reduces the effect of precipitation hardening characteristic of the recrystallized metal, and at the optimal aging temperature eliminates it completely. The aging process, which is responsible for the temperature dependence of the mechanical properties, occurs in the Mo−C−Zr and Mo−C alloys at 900 to 1800, with a peak of 1600°C. With the application of stress, i.e., in mechanical tests, the temperature of the maximum precipitation hardening decreases to 1400°C. The solid solution decomposes due to precipitation of finely dispersed ZrC particles. The large particles of Mo_2C precipitating as excess phase during quenching of Mo−C−Zr alloys and in Mo−C alloys after all heat treatments are not a hardening phase. (auth)

21812 AGING OF Nb−W−Zr−C ALLOYS. Ivanova, K. N. Metal Sci. Heat Treat. (USSR) (Engl. Transl.); 16: No. 1-2, 125-129(1974).

Translated from Metalloved. Term. Obrab. Metal; 16: No. 2, 30-35(Feb 1974).

Precipitation hardening of Nb-base−W−Zr−C alloys was investigated. The alloys, aged at 1200°C for 1, 10, and 100 h, were

subjected to microstructural analysis, x-ray analysis, and hardness measurements. Intensive aging accompanied by an increase of hardness at 20°C occurs in alloys with zirconium and tungsten only with the addition of 1.5 to 2 at. % C, i.e., when a sufficient volume percentage of the hardening carbide phase is precipitated. Precipitation hardening is due to the precipitation of monocarbide phase (Zr, Nb, W)C, as was determined by x-ray analysis. In the presence of carbides, W_2Zr does not increase the hardness of the alloys at 20°C. The short-term and long-term red hardness of the alloys at temperatures of 400 to 1200°C increase with the zirconium and carbon concentrations. (auth)

21813 MECHANICAL PROPERTIES OF HIGH-STRENGTH STEELS. Gulyaev, A. P.; Zikeev, V. N.; Guseinov, R. K. Metal Sci. Heat Treat. (USSR) (Engl. Transl.); 16: No. 1-2, 38-40(1974).

Translated from Metalloved. Term. Obrab. Metal; 16: No. 1, 38-41(Jan 1974).

The properties of steels containing medium-level C, 9% Ni, and 4% Co designated 30N9K4 and 18Kh2N4VA were studied. Results show that under optimal conditions, steel 30N9K4 has the same toughness as steel 18Kh2N4VA and a higher strength (20 kg/mm^2 higher). The combination of mechanical properties is the same for steel 30N9K4 as for maraging steel N18 · K8M3T, although it contains only half as much nickel and cobalt. (JRD)

Radiation Effects

Refer also to abstracts 23107 and 23152.

21814 (FRNC-TH-493) MECHANICAL PROPERTIES OF PURE IRON IRRADIATED AT LOW TEMPERATURES. Irradiation Softening Mechanism. Vanoni, F. (Grenoble-1 Univ., 38 (France)). 1973. 93p. (In French). Dep. NTIS (US Sales Only) $7.75.

Thesis. Submitted to Universite Scientifique et Medicale de Grenoble (France).

The effect of point defects introduced by neutron and electron irradiation on the mechanical properties of iron at low temperatures (77°K) was studied. Tensile tests were used to investigate the mechanical properties and microscopic metallography for observations of the sample surfaces. Results indicate that the presence of isolated self-interstitials results in a considerable drop in the elastic limit at low temperatures and the elimination of twinning phenomena. When annealing is carried out subsequent to neutron irradiation, a two-stage hardening process occurs, the different stages corresponding to the successive agglomeration of interstitials and vacancies. (64 references, 42 fig) (FR)

21815 (HEDL-TME-74-1(Vol.1)) HEDL QUARTERLY TECHNICAL REPORT, JANUARY–MARCH 1974. Volume I. Materials Technology. Evans, E. A. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Apr 1974. Contract AT(45-1)-2170. 325p. AT.

Research progress is reported on ceramic fuels, control elements, mechanical metallurgy, irradiation damage, component fabrication, radioactive materials processing, and sodium technology. (JRD)

21816 (INIS-MF-1238, pp 4-8) CRYOSTAT FOR THE IRRADIATION AND ANNEALING EXPERIMENTS. Afman, H. B. (Univ., Amsterdam). 6 Sep 1972.

A number of publications has been gathered concerning lattice defects in molybdenum inasmuch as these are caused by high-energy (1 to 2 MeV) electron irradiation. These irradiations took place while the specimens were at room temperature or at the temperature of liquid helium. In the latter case a cryostat was used; it is described. Its main features are: The samples are irradiated while immersed in liquid helium. Their resistivity is measured in the same circumstances. To heat the samples to a preset temperature they are placed in a temperature-regulated block. The warming-up time of the sample is relatively small, so an annealing procedure can be performed accurately at a fast cycling time. The liquid helium consumption because of heat leakage is sufficiently low that the samples can be kept cold overnight. So it is less troublesome to perform experiments of long duration. The samples can be replaced or inspected even when the cryostat is in operation. Apart from the description of the cryostat, the thesis contains five journal articles and a chapter of remarks concerning them. (INIS)

21817 (IS-3405) RADIATION EFFECTS ON FRACTURE BEHAVIOR. Wechsler, M. S. (Iowa State Univ. of Science and Technology, Ames (USA)). Jun 1974. 7p. (CONF-740640-1). Dep. NTIS $4.00.

From summer study on radiation effects on materials; Upton, New York, USA (17 Jun 1974).

Deficiencies in the technology of radiation embrittlement are examined. Information and discussions are included on radiation embrittlement in nominally ductile metals, radiation effects on ductile-brittle transition in bcc metals, and high-temperature grain boundary radiation embrittlement. (JRD)

21818 (KHFTI-72-45, pp 26-27) ELECTRON IRRADIATION EFFECT ON THE ADHESION OF THIN METALLIC FILMS. Gritsyna, V. T.; Polyakov, N. I. 1972. (In Russian).

A method for the study of the irradiation in air of glass-deposited Cu films irradiated with electrons was described. The measurement of the adhesion was made on a tensile-strength device with rate of separation of the clamp of 2×10^{-4} mm/s. The dependence of the adhesive force on the thickness of Cu film and on the irradiation with 10-MeV electrons was shown. On the basis of an analysis of the results an explanation of the adhesion mechanism was proposed. (tr-auth)

21819 EFFECT OF RADIATION DEFECTS ON THE ELECTRIC RESISTANCE ON TUNGSTEN MONOCRYSTALS. Bykov, V. N.; Birzhevoi, G. A.; Zakharova, M. I.; Solov'ev, V. A. pp 159-160 of Splavy Redkikh Metallov s Osobymi Fizicheskimi Svoistvami. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian)

A study was made of the specific electric resistance at temperatures of 298, 77, and 4.2°K of monocrystalline W irradiated at temperatures from 450 to 500°C at a dose of 1.4×10^{22} n/cm^2 (4×10^{21} n/cm^2, E = 1 MeV). As a result of annealing in the temperature interval from 200 to 2200°C, three stages of recovery of the electric resistance were observed; They correspond to the three types of radiation defects with activation energies of 0.70 ± 0.03, 3.2 ± 0.3, and 6.4 ± 0.5 ev. An irreversible change of the electric resistance caused by the accumulation of Re in the W as a result of (n, γ) reactions was found. (tr-auth)

21820 KINETICS OF THE ANNEALING OF RADIATION DEFECTS OF NEUTRON-IRRADIATED MOLYBDENUM. Bykov, V. N.; Zakharova, M. I.; Kostromin, L. G.; Shcherbak, V. I. Fiz. Metal. Metalloved.; 37: No. 5, 937-942(May 1974). (In Russian).

The kinetics of the annealing of radiation defects in Mo irradiated with an integral neutron flux of 1.4×10^{22} n/cm^2 (4×10^{21} n/cm^2 with E > 1 MeV) were studied at a temperature of 470 ± 30°C. The energies of the activation energy for the annealing of radiation defects and the temperature intervals for their stability were determined. On the basis of the data and results from a transmission electron microscope, an interpretation was given of the types of defects accumulated in the Mo during irradiation under the conditions cited. (tr-auth)

21821 RADIATSIONNAYA STOIKOST' MATERIALOV. Spravochnik. (Radiation Stability of Materials. Handbook). Dubrovskii, V. B. (ed.). Moscow; Atomizdat (1973). 264p.

Data are presented on the radiation stability of construction materials used in reactors. The physical, thermal, and dielectric properties are given as a function of the ionizing radiation. The change in properties is considered with respect to data obtained under normal conditions. The first section covers metals such as iron, carbon steel and alloy steels. The nonmetals are discussed under minerals, ores, concretes, graphite and glass in the second section. Polymers are covered in the third section. (SJR)

21822 METHOD FOR REDUCING EMBRITTLEMENT CONDITION OF METAL. Blosser, R. W.; Richard, G. L. US Patent 3,817,849. 18 Jun 1974. Filed date 29 Oct 1970. 6p.

An improved method is given for reducing the condition of embrittlement in a metal specimen with both heat and a neutron flux of selected density. The method consists of placing a metal specimen, in heated environs and in view of neutron radiation for a predetermined period of time in order to alleviate any embrittlement condition and/or to reduce likelihood of such condition at a later time, such heat/neutron irradiation tending to rearrange the interstitial makeup of the metal specimen, e.g., by bringing about dissociation of diatomic or molecular hydrogen to its monatomic state. (Official Gazette)

21823 DEFECTS INDUCED BY ELECTRON IRRADIATION IN p-TYPE GERMANIUM AT LOW TEMPERATURES. Matula, R. A. Lafayette, IN; Purdue University (1973). 164p. University Microfilms Order No. 74-5008.

Thesis (Ph. D.).

Non-degenerate p-type germanium of higher purity (15 ohm-cm) than previously used has been irradiated by 1 MeV electrons at temperatures near liquid helium. Essentially no change in carrier concentration and mobility is observed following irradiation indicating defects formed are in their neutral state. Subsequent illumination with filtered light produces a decrease in conductivity with time, which follows the sum of two exponentials. The characteristic decay times of the two exponentials are found to change for various experimental conditions. A higher constant light in-

tensity is correlated with a decrease in both the long and the short decay times and can be explained by the greater number of incident photons per unit time. A higher initial carrier concentration is correlated with an increase in decay times; after isochronal annealing to 78°K the decay time increases for subsequent application of filtered light; and residual defects, due to a series of irradiations, is correlated with a slight increase in the long decay time. Electrons with energies as low as 350 keV, when applied after filtered light to completion, cause both annealing and rearrangement of defects to take place. The greater change in decay times with 350 keV electrons applied to the ionized defects, compared with their effect on the neutral defects, indicates the charge state of the defect is important in determining its alteration. There is also a correlation between 1 MeV electrons applied to the ionized defects and an increase in decay times. Results of mobility calculations indicate that after filtered light to completion defect centers are singly charged. White light anneals out defects at low temperatures, whether they are in their neutral or ionized state. A heat pulse (300 s at 81°K) applied immediately after a 1 MeV bombardment, but before filtered light, gives results that are contradictory to the previously proposed model based on a vacancy-interstitial close pair. Using the premise of a mobile interstitial, a new model is proposed to explain the low temperature behavior. An estimate of about 0.2 eV is obtained for the electronic energy level of the long decay time component. The short decay time component is thought to have a slightly higher electronic energy level. (Diss. Abstr. Int., B)

21824 THERMAL EVOLUTION SPECTROMETRY OF LOW ENERGY HELIUM IONS INJECTED INTO STAINLESS STEEL AND NICKEL TARGETS. Reed, D. J.; Harris, F. T.; Armour, D. G.; Carter, G. (Salford Univ., Eng.). Vacuum; 24: No. 4, 179-186(Apr 1974).

Low energy helium ions have been injected in 304 stainless steel, polycrystalline nickel foil, and single crystal nickel targets and the gas evolution rate monitored during post-bombardment annealing. Peaks in the observed spectra have been associated with annealing of radiation damage, normal diffusion, and with processes involving helium-vacancy agglomerates. Activation energies for evolution have been deduced and values in good agreement with previously published experimental and theoretical results have allowed identification of some of the processes. Entrapment probabilities have also been measured and found to be lower in stainless steel than in nickel due mainly to the inability to remove all the gas implanted into the steel without melting it. The marked fluence dependence of the entrapment probability in single crystal nickel for the higher energy (1 keV) and high fluence (10^{15} to 10^{16} ions cm^{-2}) range investigated illustrated the importance of gas atom-defect interactions in the migrational behavior of helium in this material. (auth)

21825 HARDENING OF TUNGSTEN CARBIDE BY IRRADIATION. Fremlin, J. H.; Askouri, N. A. (Birmingham Univ., Eng.). Nature (London); 249: No. 5453, 137(10 May 1974).

A remarkable degree of hardening of standard tool-making grades of singered W carbide in a Co matrix by charged particle irradiation is reported. Up to 5μA/cm^2 of 32 MeV ^{3}He ions in the Birmingham University 150 cm cyclotron were used for the irradiation, and the maximum dose given was 1.6×10^{17} ions/cm^2 (3×10^{11} R). The ions penetrated to a depth of about 140 μm, and the temperature did not rise above 400°C during irradiation. Hardness was measured using Vickers testing machine, and results are shown graphically. About 30% increase in hardness occurred at a dose of the order of 10^{17} ions/cm^2. (UK)

21826 EFFECTS OF ELECTRON IRRADIATION ON P-TYPE GERMANIUM AT LIQUID HELIUM TEMPERATURES USING AC HOPPING CONDUCTIVITY. Roop, R. M. Urbana, IL; Univ. of Illinois (1973). 308p. University Microfilms Order No. 74-12,164.

Thesis (Ph. D.).

P-type germanium single crystals (8×10^{14} Ga/cm^3 and 6×10^{15} Ga/cm^3) were irradiated with 1.1 MeV electrons at pumped liquid helium temperatures and defect production and annealing studied using ac hopping conductivity. Production rates obtained from measurements at 1.5°K and 10^4 Hz were .6 cm^{-1} for samples doped 6×10^{15} Ga/cm^3 and .11 cm^{-1} for samples doped 8×10^{14} Ga/cm^3. Above 10^{16} e/cm^2 fluence the production rates for the higher doped samples decreased to approximately .06 cm^{-1} at 10^{15} e/cm^2 fluence except for one sample which was anomalous. No such long irradiation of the low doped samples was made. The apparent inconsistency between these results and production rates of less than 3×10^{-4} cm^{-1} observed by previous workers has been resolved by introducing a donor level for the defect produced by irradiation near the chemical acceptor level, so that the defect would be neutral at temperatures near 30°K and charged +1 at 1.5°K. Some surface effects were seen which did not affect production rate measurements at 1.5°K more than ±10% but did influence annealing behavior at 100°K. The fact that the production rate observed increases with the impurity concentration indicates that some defects must be mobile at the irradiation temperatures, which were usually 1.8°K. The fact that the production rate was 0.11 cm^{-1} ±27% in the low doped p-type samples instead of 1.4 cm^{-1} or 0.95 ± .05 cm^{-1} as observed by other workers in n-type samples of similar dopant concentration also supports this conclusion. This led to the suggestion that germanium and silicon are similar as far as lattice vacancy and interstitial behavior. The similarity of the migration energies of the doubly negative vacancy in silicon to the activation energy of the 65°K stage in n-type germanium thus indicates that this stage could be due to vacancy migration. The migration energy of the neutral vacancy in silicon is similar to the activation energy of the 200°K stage in p-type germanium observed by other workers. (Diss. Abstr. Int., B)

21827 ANNEALING OF DEFECTS INDUCED BY ELECTRON IRRADIATION OF GOLD. Substructure of Annealing Stage III. Arbuzov, V. L.; Baldin, A. V.; Buzynov, A. E.; Klotsman, S. M.; Matvienko, A. F.; Medvedev, G. V.; Pavlov, V. A. (Inst. of Physics of Metals, Moscow). Fiz. Metal. Metalloved.; 37: No. 3, 544-553(Mar 1974). (In Russian).

Gold, 99.9999% pure, was irradiated with 3-MeV electrons from a linear accelerator, with essentially constant beam intensity and irradiation temperature. Changes were observed in the annealing spectrum of the electrical resistance with total electron dose. The substructure of annealing stage III showed peaks at 185, 230, 280, 315, 345, and 370°K. The dose dependence of the areas of peaks III-A and III-B and the difference in the order of the reaction of these peaks is explained by the fact that annealing of the radiation defects in these two substages is due to decay of the injection-impurity complex possibly occurring in two different states, to diffusion of the liberated injections to vacancies in III-A or to external escape in III-B, and to destruction of the migrating implantation. (tr-auth)

21828 EFFECT OF NEUTRON IRRADIATION ON STRUCTURAL CHANGES IN ANNEALING DEFORMED ALUMINUM SINGLE CRYSTALS. Larikov, L. N.; Plotnikova, N. P. (Inst. of Metal Physics, Kiev). Ukr. Fis. Zh. (Russ. Ed.); 19: No. 5, 737-742(May 1974). (In Russian).

Neutron irradiation with a dose of 5×10^{19} n/cm^2 at a temperature of 70°C of deformed aluminum single crystals does not affect essentially the final recrystallization structure but results in some dispersion of the recrystallization texture. (tr-auth)

21829 USING CHARGED PARTICLE ACCELERATORS TO EVALUATE REACTOR MATERIALS. Worth, J. H. (Atomic Energy Research Establishment, Harwell, Eng.). J. Inst. Nucl. Eng.; 15: No. 3, 67-73(May 1974).

An acoount is first given of the development of the use of charged particle accelerators in the study of radiation effects in solids. A brief description is given of the Harwell variable energy cyclotron. Among other matters discussed are: selection of ion beams for various experiments; experimental equipment-beam handling and measuring equipment, target chambers and cold tunnels, rocking target control equipment, energy absorbing wedges, and ancillary equipment. It is stated that the main design problems are concerned with the need to dissipate the beam power while maintaining close temperature control. Much of the ancillary equipment is concerned with the early detection of faults, and the complexity of fault monitoring and data logging has led to the design of a computer controlled system. Examples are given of the application of cyclotrons to materials science. Results are being obtained in less than a year, under closely controlled conditions of dose and temperature, that would have taken a number of years with reactors, and without the complications inherent in reactor experiments. (UK)

21830 LOCALIZED DEFORMATION AND FRACTURE IN NEUTRON IRRADIATED ZIRCALOY-2. Rosenbaum, H. S. (General Electric Co., Pleasanton, CA); Rieger, G. F.; Lee, D. Met. Trans.; 5: No. 8, 1867-1874(Aug 1974).

An examination of the deformation bands and the fracture surface morphologies was made with neutron-irradiated Zircaloy-2 sheet that had been prepared with similar compositions and microstructures, but with different crystallographic textures. These materials were irradiated at 600°K to fluences up to 2×10^{21} n/cm^2 (E > 1 MeV). Tests were made in simple tension and in plane strain tension at 523°K and at a strain rate of 0.05 min^{-1}. In the material with (0002) poles predominantly parallel to the normal of sheet sample, the specimen tested in simple tension was macroscopically deformed in a manner consistent with the expected slip direction $\langle 11\bar{2}0 \rangle$. However, within

individual grains, "pencil glide" deformation was noted where the slip direction was shared by more than one slip plane. The slip planes are of the type $\{10\bar{1}l\}$, where the most likely values of l are 0 and 1. The deformation was in sharply defined bands reminiscent of Lueders bands. In other materials, where (0002) poles were tilted toward the tensile direction, deformation occurred in less localized manner. In plane strain tension, however, the same materials fractured with very little plastic deformation, but with indications that small amounts of shear deformation occurred in a direction not parallel to the basal plane. The fracture morphologies were strongly affected by texture in the simple tension tests. In plane strain, however, the fracture morphologies were determined more by the constraints of the test than by the texture of the material in spite of the large differences in fracture stress that have been observed in materials with different texture. (7 figures) (auth)

21831 DEVICE FOR TESTING A MATERIAL'S CREEP AND LONG-TERM STRENGTH WHEN EXPOSED TO RADIATION IN CORROSIVE MEDIA. Yurchenko, B. I.; Samsonov, B. V.; Mel'nichenko, I. V.; Petrenko, A. I.; Kiselevskii, V. N.; Losev, N. P. (Inst. of the Strength of Materials, Kiev). Strength Mater. (USSR) (Engl. Transl.); 5: No. 6, 760-762(Jun 1973).

Translated from Probl. Prochnosti; 5: No. 6, 108-110(Jun 1973).

The device consists of three main parts: a sealed capsule, a supporting tube with a system of grips, and the loading mechanism incorporating a hydraulic cylinder with flexible long-stroke diaphragms. The specimen is placed in the niobium capsule. (Among all refractory metals niobium is most suitable for operation in contact with lithium at high temperatures). Because of the high-temperature (1000 to 1200°C), the capsule is sealed to prevent liquid lithium (^{7}Li) from filling the capsule to three lengths of the specimen, evaporating from the specimen zone, and flowing into the reactor channel. One end of a bellows is welded to the capsule top and another to the grip to provide mobility of the latter even if capsule is hermetically sealed. A bushing connects the capsule in the casing and prevents its movement; this casing is placed in the test channel in such a manner that the working part of the specimen is exactly in the center of the active zone of the reactor. The bottom capsule end (a niobium cup with the stationary grip) can freely expand along the casing thereby preventing the specimen from deforming especially under unsteady temperature conditions. The pressure in the unsealed part of the device is maintained at the same level as in the channel carrying the helium flow (13 to 15 kg/cm^2) but it can vary during the test. The pressure difference between the sealed and unsealed parts of the device applies a load to the specimen. Since it can change during the test, a provision is made for its adjustment. A bellows is mounted above the hydraulic cylinder in the volume of the body communicating through the gap between the rod and cup of the cylinder with the medium contained in the reactor channel. One end of the bellows is welded to a rod of the hydraulic cylinder and the other end to a pin fixed to the body. These bellows are joined by piping and holes in the rod. Since the maximum test temperature in the active zone center reaches 1000 to 1200°C, evaporation of the liquid from the specimen zone and its solidification is prevented by use of a Li vapor trap. (auth)

21832 SYSTEM FOR THE REMOTE MEASUREMENT AND AUTOMATIC RECORDING OF LINEAR DISPLACEMENTS WHEN TESTING CONSTRUCTION MATERIALS IN A FIELD OF REACTOR RADIATION. Kiselevskii, V. N.; Polevoi, D. V.; Losev, N. P. (Inst. of the Strength of Materials, Kiev). Strength Mater. (USSR) (Engl. Transl.); 5: No. 6, 763-767(Jun 1973).

Translated from Probl. Prochnosti; 5: No. 6, 111-115(Jun 1973).

The design is described of an electrical differential-transformer system for remote measurement and automatic recording of the elongation of a fixed base in a test specimen. The elongation is measured by means of an inductive sensor-type pickup compensated for thermal deformations. (JRD)

Other Materials

Refer also to abstracts 20684, 20692, 21513, 21518, 21757, 21821, 22162, 22179, and 23082.

21833 (ARH-SA-195) TEN YEARS WITH PLASTICS IN NUCLEAR PROCESSING. Bruns, L. E. (Atlantic Richfield Hanford Co., Richland, Wash. (USA)). Aug 1974. Contract AT(45-1)-2130. 15p. (CONF-740804-1). Dep. NTIS $4.00.

From American Institute of Chemical Engineers; Salt Lake City, Utah, USA (18 Aug 1974).

The number one priority in the operation of nuclear processing plants is safety. Atlantic Richfield Hanford Company at Richland, Washington, has used plastics throughout the processing plants for safety and improved efficiency reasons. Beneficial use of polyvinylidene fluoride (Kynar), polytetrafluoroethylene (Teflon) and other plastics is described. (auth)

21834 (EUR-4813) THERMAL CONDUCTIVITIES OF COMPOSITE MATERIALS BASED ON VARIATIONAL PRINCIPLES. Donea, J. (Commission of the European Communities, Brussels (Belgium)). 1972. 46p. INIS.

Two variational principles associated with the equation of heat conduction are applied to the derivation of upper and lower bounds for the effective thermal conductivity of composite materials. Exact bounds are obtained for specified phase-geometries using a concentric-spheres model for materials with particle inclusions and a concentric-cylinders model for solids reinforced by parallel circular fibers. (INIS)

21835 (JUL-1052-RW) PYROCARBON, AN IMPORTANT MATERIAL FOR HIGH TEMPERATURE GAS COOLED REACTORS. Gyarmati, E.; Koizlik, K.; Krautwasser, P.; Luhleich, H.; Nickel, H.; Schulze, H. A. (Kernforschungsanlage Juelich G.m.b.H. (F.R. Germany). Inst. fuer Reaktorwerkstoffe und Heisse Zellen). Mar 1974. 30p. Dep. NTIS (US Sales Only) $4.50.

The present state of pyrocarbon technique is summarized for application to reactor technology. Deposition methods are described as well as the methods for characterization of the pyrocarbon deposits. Latest results of structural analysis of this material are presented. Theoretical model conceptions of pyrolysis and deposition mechanism and of microphysical processes during neutron irradiation and heat treatment of pyrocarbon coated fuel particles are described, and the experiments, which these models are based upon. (14 figures, 27 references) (auth)

21836 (KHFTI-72-45, pp 25-26) ANNEALING AND DEFORMATION EFFECTS ON THE COLORING OF KBr CRYSTALS UNDER THE 10-MeV ELECTRON IRRADIATION. Gritsyna, V. T.; Lebedev, V. N.; Korneeva, T. I.; Ryabka, P. M. 1972. (In Russian).

The results of the study of the effect of the original dislocation density on the kinetics of the formation of F centers in monocrystals of KBr are reported for a wide dose range during irradiation with high-energy electrons. Freshly spiked, annealed, and deformed crystals, in which the dislocation density was 1.8×10^6, 9×10^5, and 9×10^6 cm^{-1} respectively, were studied. The dependence of the concentration of F centers on the absorbed dose was shown for the types of crystals studied. (tr-auth)

21837 (KHFTI-72-45, pp 27-28) ROLE OF DIRECT FORMATION OF FRENKEL PAIRS IN COLORING ALKALI-HALIDE CRYSTALS UNDER FAST ELECTRON IRRADIATION. Gritsyna, V. T.; Lebedev, V. N. 1972. (In Russian).

The results of the study of the kinetics of the coloring of alkali-halide crystals with 10-MeV electrons in the dose range from 2×10^{12} to 6×10^{15} MeV/cm^3 were reported. It was shown that the dependence of the growth of F centers in KCl crystals has a three-stage character with individual linear ranges. The functional dependence of the concentration of color centers on the irradiation dose was determined by the original defects of the crystals, by the crystal contamination, and by the dynamic conversion of the anion-cation vacancies and interstitial atoms. (tr-auth)

21838 (ORNL-TM-4604) EFFECTS OF NEUTRON IRRADIATION UPON METALLOGRAPHIC MOUNTING MATERIALS. Reed, R. E.; Bolling, E. D.; Emery, J. F. (Oak Ridge National Lab., Tenn. (USA)). Aug 1974. Contract W-7405-eng-26. 17p. Dep. NTIS $4.00.

The effect of neutron irradiation upon two epoxy base mounting materials was determined in order to select the appropriate material for an autoradiographic technique which required that both the specimen and the mounting material be irradiated together. "Hysol" and "Araldite" epoxies, some with pelletized alumina powder additives, were neutron irradiated to a fluence of 7×10^{18} n/cm^2 in the Bulk Shielding Reactor at ORNL. All of the alumina additions tested had unsatisfactory gamma activity levels after neutron irradiation because of impurities in the alumina. The plain hysol epoxy was chosen over plain araldite epoxy because of its higher hardness, better dimensional stability under neutron irradiation, and lower activity after neutron activation. (auth)

21839 (SGAE-2217) STRUCTURAL CHANGES IN PYROCARBON COATINGS OF SPHERICAL PARTICLES BY HEAT TREATMENT AND NEUTRON IRRADIATION. Koss, P.; Koizlik, K.; Nickel, H.; Balthesen, E. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Inst. fuer Metallurgie). Feb 1974. 10p. (CONF-730601-7). Dep. NTIS (US Sales Only) $4.00.

From 11th Biennial conference on carbon; Gatlinburg, Tennessee, USA (4 Jun 1973).

The microstructure of pyrocarbon coatings of fuel particles deposited in a fluidized bed changes during heat treatment or fast neutron irradiation. A study of the structural parameter anisotropy of orientation which is very important of the estimation of the life time of particles in a reactor is presented.

Heat treatment temperature varies from 1800 to 2400°C. Fast neutron dose (E > 0.1 MeV) ranges up to $16 \cdot 10^{21}$ cm^{-2} and the burnup of the kernels reaches 17% fissions per initial metal atom (fima). All results show an increase of the anisotropy by heat treatment and neutron irradiation. The amount of this increase depends on temperature, fast neutron dose, burnup, and on the starting values of material properties. (auth)

21840 SPRING SESSION OF THE SOLID STATE PHYSICS COMMITTEE OF THE GERMAN PHYSICS SOCIETY REPRESENTING COMMITTEES ON HIGH FREQUENCY PHYSICS, THERMODYNAMICS AND STATISTICAL MECHANICS, AND LOW TEMPERATURES AND THE SEMICONDUCTOR AND METAL PHYSICS SOCIETY, FREUDENSTADT, GERMANY, APRIL 1–5, 1974. Abstracts. Weinheim, Ger.; Physik Verlag GmbH (1974). 312p. (In German and English). (CONF-740451–(Absts.)).

From Conference on solid state physics; Freudenstadt, F. R. Germany (1 Apr 1974).

Abstracts of the papers presented at the conference are compiled. Topics discussed were elastic properties, optical properties, phonon excitation, crystal structure, neutron scattering, self-diffusion, magnetic properties, antiferromagnetism, thermodynamic properties, and electronic structure. (SFL)

21841 EXTRACTION EQUILIBRIA OF Lu, Yb, AND Tm BETWEEN DI-(2-ETHYLHEXYL) PHOSPHORIC ACID IN AMSCO AND ACQUEOUS HYDROCHLORIC ACID SOLUTIONS. Thomas, N. E.; Burkhart, L. E. (Ames Lab., IA). J. Inorg. Nucl. Chem.; 36: No. 6, 1369-1376(Jun 1974).

Single-component equilibrium data for the extraction of lutetium and ytterbium from aqueous hydrochloric acid solutions by 1M di-(2-ethylhexyl) phosphoric acid in Amsco Odorless Mineral Spirits were obtained over a wide range of equilibrium aqueous rare earth chloride concentrations and at an equilibrium aqueous acidity of 5M HCl. These data were compared with data taken earlier for thulium. The shapes of the organic-phase loading isotherms (or equilibrium curves) for Lu, Yb, and Tm are similar and have been interpreted on the basis of several probable extraction reactions. Under the conditions studied, the extractability of the rare earths increased in the order Tm < Yb < Lu. It was possible to correlate the data empirically in terms of total rare-earth metal concentrations. (auth)

21842 EFFECT OF γ-IRRADIATION ON THE CRYSTALLINE TRANSITION TEMPERATURE IN POLY(TETRAFLUOROETHYLENE). Tutiya, M. (Tokyo Metropolitan Isotope Research Center). Polym. J.; 6: No. 1, 9-44(Mar 1974).

The effect of γ-irradiation on the 19°C transition of poly(tetrafluoroethylene) was studied with broad-line NMR and the transition temperature was measured as a function of total dose up to 10^9R. The transition temperature is lowered with increasing dose in all the following cases: (a) room-temperature irradiation, (b) room-temperature irradiation with subsequent annealing, and (c) irradiation above the melting point. In case (b), the lowering of the transition temperature is attributed to the main-chain scission in the crystalline phase. In case (a), in addition to the scission, the occlusion of degradation products is effective, and in case (c), the formation of side-branches (–CF_3) plays an important role. Results are analysed by a theory of rotational phase transition and a satisfactory agreement between theory and experiment is obtained. (auth)

21843 RADIATION HARDENING OF NaCl WHISKERS. Demidova, N. N.; Gol'denberg, S. U. (Kuzbas Polytechnical Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 4, 139-141(1974). (In Russian).

The effect of x-radiation on the tensile strength and character of the deformation of NaCl whiskers was studied. The results showed that x-irradiation leads to hardening of the whiskers and the degree of hardness increases with decrease of the diameter. The fracture character of the whiskers is altered by irradiation. Before irradiation the samples fracture plastically. After irradiation the samples are brittle. (JSR)

21844 OPTICAL STUDIES OF IMPURITIES AND RADIATION INDUCED DEFECTS IN $KMgF_3$. Yun, S. Stillwater, OK; Oklahoma State University (1973). 133p. University Microfilms Order No. 74-8148.

Thesis (Ph. D.).

The radiation damage in $KMgF_3$ crystals was studied. The luminescence and the mechanism involved in the enhancement of the Mn^{2+} ion transitions in irradiated $KMgF_3$: Mn crystals were also studied. For the former study, the emission from either electron or γ-irradiated $KMgF_3$ was examined by means of the polarized bleaching, polarized emission, and the excitation spectrum techniques. For later study, the optical absorption and luminescence resulting when $KMgF_3$: Mn crystals were irradiated with 2 MeV electrons at temperatures 80 and 300°K were examined. The optical absorption and luminescence were analyzed by means of oscillator strength, lifetime, and the temperature dependence of luminescence. It was found that F_2 centers have absorption bands at 282 and 445 nm and an emission at 590 nm. F_3 centers absorb light of 250 and 395 nm and emit light of 465 nm. Both of these centers can be reoriented by optical polarized bleaching and F_2 centers reorient by 60° jump. The band responsible for 570 nm absorption band emits light of 750 nm. The absorption bands due to an F center trapped at a fluorine site between two adjacent substitutional Mn-ion impurities (Mn-F-Mn) have been assigned to various energy levels by means of polarized bleaching experiments and crystal field theory. The spin forbiddeness of the transition is lifted by the exchange interactions of three paramagnetic ions, the Mn^{2+} pair and an F center, and the parity forbiddeness is also lifted by the trapped F center between two Mn^{2+} ions. It was also found that spin forbiddeness is more effective in the transition probabilities of Mn^{2+} than parity forbiddeness. Four vibronic absorption bands at 435, 426, 394, and 597 nm were described as due to one of the T_{1u} vibrational frequencies, 478 cm^{-1}, of $KMgF_3$ lattice. The luminescence from these Mn-F-Mn defects in low temperature irradiated $KMgF_3$: Mn was studied and found to consist of two bands. One of these, the 677 nm band, is a partially forbidden transition with a long lifetime, 4.8×10^{-4} s at low temperature, whereas the 630 nm band seen at room temperature is an allowed transition with a relatively short lifetime of 16×10^{-6} s. (Diss. Abstr. Int., B)

21845 APPLICATION OF JACOBI POLYNOMIAL METHODS TO THE ONE-SPEED TRANSPORT EQUATION. Mueller, G. P. (Naval Research Lab., Washington, DC). Radiat. Eff.; 20: No. 4, 229-237(1973).

The transport equations associated with radiation damage studies were often solved using expansions in Legendre polynomials. The radiation damage distribution functions which satisfy these equations may be sharply peaked in the forward direction, while the Legendre polynomials, as a set, are isotropic. This situation requires the use of many terms in the Legendre expansion in order to adequately represent the distribution functions. The Jacobi polynomials, on the other hand, can have strong peaking built into their associated weight function. To test the usefulness of the Jacobi polynomials we use them to solve the simple, one-speed, neutron transport equation. The results are then compared to the exact theory and to the results of applying Legendre methods to the same problem. This sample calculation demonstrates the advantage of the Jacobi polynomials in strongly non-isotropic situations. (auth)

21846 LATTICE DISORDER STUDIES IN LOW-TEMPERATURE NITROGEN-IMPLANTED SILICON. Pronko, P. P. (McMaster Univ., Hamilton, Ont.); Mitchell, J. B.; Shewchun, J.; Davies, J. A. Radiat. Eff.; 20: No. 4, 257-263(1973).

The amount of lattice disorder and its depth distribution in silicon crystals implanted to a total dose of 10^{14} nitrogen ions/cm^2 at 80 keV was investigated as a function of implantation temperature (25 to 300°K) and of dose rate (5 to 500 na/cm^2), using the helium-backscattering technique. Evidence was found for a strong reverse-annealing stage at the lower temperatures (<80°K), indicating the existence of mobile defects in silicon down to 25°K. The depth distribution and dose-rate dependence of damage resulting from this reverse annealing stage implies the existence of an ionization-induced mobile defect, probably the negative vacancy. (auth)

21847 THEORY OF IRRADIATION CREEP IN REACTOR GRAPHITE. The Dislocation Pinning–Unpinning Model. Kelly, B. T. (United Kingdom Atomic Energy Authority, Springfields); Foreman, A. J. E. Carbon; 12: No. 2, 151-158(Apr 1974).

The theory of creep of a graphite crystal under fast neutron irradiation is developed assuming that it occurs by basal slip activated by fast neutron induced atomic displacements. The basal slip rate is calculated for dislocations gliding through an array of pinning points which are both created and destroyed by irradiation. It is shown that the parameters necessary for this theory to fit experiment are quite compatible with changes in other properties of crystallites under irradiation in the same conditions. (auth)

21848 HIGH-TEMPERATURE NEUTRON IRRADIATION OF HIGHLY ORIENTED CARBONS AND GRAPHITES. Price, R. J. (Gulf General Atomic Co., San Diego, CA). Carbon; 12: No. 2, 159-169(Apr 1974).

Highly oriented massive pyrolytic carbons were annealed at 2900 to 3300°C to produce apparent crystalline heights (L_c) ranging from 220 Å to 1660 Å. Transmission electron microscopy showed that annealing progressively increased the crystallite width, while the height between twist boundaries was little changed over most

of the annealing range. The pyrolytic carbons, together with samples of hot-worked polycrystalline graphite, were irradiated with fast neutrons at 1300 to 1500°C to 2×10^{22} n/cm² (E > 0.18 MeV). Changes in dimensions, thermal expansivities, apparent crystallite heights (L_c), and unit cell heights (C_0) were measured. At 1300 to 1500°C the c-axis growth and a-axis contraction of the pyrolytic carbons increased linearly with neutron fluence, while the dimensional change rates of the hot-worked graphite decreased with increasing fluence. The dimensional change rates of the annealed pyrolytic carbons decreased systematically with increasing crystal perfection. During irradiation at 1300 to 1357°C, the thermal expansivity in the principal c-direction of as-deposited massive pyrolytic carbon increased rapidly to nearly the theoretical single-crystal value, while that of the hot-worked graphite initially increased, passed through a maximum, and then declined to less than half its initial value. (auth)

21849 OPTIMIZATION OF THE RADIATION-THERMAL CONDITIONS FOR THE FORMATION OF POLYETHYLENE–STEEL ADHESION BONDS. Pleskachevskii, Yu. M.; Kolychenkova, T. G. (Inst. of the Mechanics of Metallopolymer Systems, Minsk). Vestsi Akad. Navuk BSSR, Ser. Fiz.-Tekh. Navuk; No. 2, 115-118 (1974). (In Russian).

It was shown that the use of sublayers from previously irradiated polyethylene makes it possible to increase sharply the adhesion of polyethylene films to metals. The optimum conditions of radiation and thermal-time parameters for the production of high-density high-strength adhesion bonds of polyethylene with steel were determined. (tr-auth)

21850 KINETICS AND MECHANISMS OF ROOM-TEMPERATURE F-LIGHT BLEACHING IN IRRADIATED NaCl. Jaque, F.; Agullo-Lopez, F. (Univ., Madrid). Cryst. Lattice Defects; 5: No. 1, 65-71(Jan 1974).

The kinetics of the slow component of the room-temperature F-bleaching curve has been thoroughly investigated in γ-irradiated NaCl. By using a sequential illumination technique it has been shown that the mechanism for the component consists of the thermally activated reaction $F' + \alpha \rightarrow M$ together with a light-induced $F \rightleftharpoons F'$ equilibrium. This mechanism to explain the data obtained on the effect of light intensity and temperature. A light-induced contribution to the $F' + \alpha \rightarrow M$ process has been detected, which is relatively important at high illumination intensities. (auth)

21851 CRITERIA RELATIONSHIPS FOR DOSE DEPENDENCE OF RADIATION DAMAGE IN GRAPHITE. Klimenkov, V. I. At. Energ. (USSR); 36: No. 5, 356-357(May 1974). (In Russian).

Based on investigated regularities for radiation damage in graphite at low temperatures, criteria relationships are established for latent energy and swelling of graphite: $q = 1.68 \cdot 10^{-9} (t \cdot \exp 0.4\ kv)^{0.6}$; $\Delta V/V = 2 \cdot 10^{-6} (t \cdot \exp 0.4\ kv)^{0.3}$, where t = irradiation time, s, $Kv = Q/kT + \ln \Phi/\Phi_0$ – similitude criterion for irradiation conditions, Φ = flux density of damaging neutrons, n/cm² · s, $\Phi_0 = 1$ n/cm² · s, Q = 1.2 eV – activation energy for annealing of radiation defects, T = irradiation temperature, °K, k = Boltzmann constant. Satisfactory agreement of all values within measurement error with experimental data justifies the use of the relations in estimating the behavior of graphite at various locations in stacking or in differing reactors. The application of the relations is restricted to the temperature range below 335°C and doses below 10^{21} n/cm². (tr-auth)

21852 CHANGES IN THE STRENGTH PROPERTIES OF STRUCTURAL GRAPHITE. Virgil'ev, Yu. S. At. Energ. (USSR); 36: No. 6, 479-490(Jun 1974). (In Russian).

The factors determining the strength properties of structural graphite are considered. Changes in these properties and their interconnection under the action of neutron irradiation are described. Data on the non-uniformity of graphite strength properties are presented. (8 figures, 12 tables, 43 references.) (auth)

21853 RADIATION RESISTANCE OF LUBRICANTS. Rodenbusch, H.; Prokop, R. Mineraloeltechnik; 19: No. 1, 1-19 (1974). (In German).

11 figs.; 3 tabs.; 20 refs.

During static irradiation tests, the behavior of the various classes of lubricating oils and lubricating greases was examined under exposure to gamma radiation and neutrons, the radiation doses ranging from 10^6 to 10^{10} rad. In addition to conventional turbine and gear oils, various types of synthetic lubricating oils, stock oils and pure substances were examined. The radiation resistance of clay-base greases and lubricating greases with Li, Na, and Ca/Pb-complex soaps and of synthetic lubricating greases with high resistance to radiation is discussed. The maximum permissible radiation dose for the lubricants examined is calculated on the basis of the change in the chemical and physical properties. The use of lubricants in nuclear power plants and other nuclear installations and the special requirements to be fulfilled by lubricants in this field of application are dealt with. The problems relating to the disposal of lubricants, in particular turbine oils which have become radioactive, are briefly discussed. (GE)

21854 CHEMICAL VAPOR DEPOSITION OF BORON ON A CARBON MONOFILAMENT SUBSTRATE: A STUDY OF RESIDUAL STRESSES AND DEPOSITION KINETICS. Mehalso, R. M. Troy, NY; Rensselaer Polytechnic Inst. (1974). 295p. University Microfilms Order No. 74-12,788.

Thesis (Ph. D.).

Boron has been deposited by the hydrogen reduction of boron trichloride onto an inexpensive carbon monofilament substrate. The problems of deposition of boron on carbon have led to methods of estimating residual stresses, as well as new theories to describe these stresses. The stresses are estimated through the measurement of the elongation of the filament in a static reactor while under deposition conditions. Reactant gas composition, flow rate, and tension on the filament do not affect the amount of the elongation, however, temperature has a large effect. The elongation of the depositing boron creates a tensile stress in the carbon substrate causing it to fracture. The fracturing of the carbon substrate can be prevented by selecting a substrate that has optimum creep properties to match the elongation of the depositing boron. Optimizing the substrate and the deposition conditions results in boron filament with tensile strengths in excess of 1×10^6 psi. A theory has been developed that shows the elongation and resultant residual stress to be due to boron diffusion resulting in a densification of the filament. A theory backed by experimental evidence shows that the rate limiting species in the deposition of boron is the product gas HCl. Theoretical calculations compared with experimental calculations of deposition rate show that the rate is limited by a combination of the surface reaction rate and the diffusion rate of HCl. (Diss. Abstr. Int., B)

21855 STRUCTURAL PHASE TRANSITIONS, SOFT MODES, AND QUASI-ELASTIC SCATTERING. Cowley, R. A. (Univ. of Edinburgh). Ferroelectrics; 6: No. 3-4, 163-178(1974).

Experimental measurements of light and neutron scattering in materials which undergo displacive structural phase transitions have shown that there is frequently quasi-elastic response in addition to the scattering predicted by the soft mode theory. These measurements are reviewed and the phenomenological theory described. The anharmonic lattice dynamical treatment of these effects is used to show that within the framework of a Landau theory quasi-elastic scattering is expected both above and below T_c at some phase transitions, while at others only below T_c. If critical fluctuations cause a breakdown of the Landau theory close to T_c, then additional quasi-elastic scattering may be expected. The importance of these critical fluctuations may be assessed with the techniques of renormalization group theory. (auth)

21856 ANISOTROPY IN PARAELECTRIC KTN VIBRATIONAL AMPLITUDES. Abrahams, S. C.; Bernstein, J. L. (Bell Telephone Labs., Inc., Murray Hill, NJ). Ferroelectrics; 6: No. 3-4, 247-250(1974).

The integrated intensities of 892 reflections of a $KTa_xNb_{1-x}O_3$ crystal with Tc = 291°K have been measured at 298°K using the diffractometer PEXRAD. Least squares refinement of the resulting 81 symmetry-independent reflections, with conventional agreement factor R = 0.0266, shows the mean-square amplitude of thermal vibration of the oxygen atom is about 0.012 Å² in the face of the cubic unit cell, and about 0.004 Å² normal to the face. The K and composite Ta/Nb atoms have mean-square amplitudes of 0.009 and 0.008 Å² respectively. Below Tc, the large rotational mean-square amplitudes of the oxygen atom octahedra are reduced, according to Hewat et al. [Ferroelectrics, 4, 153 (1972)] to about 0.006 Å² in all directions: the metal atom vibrations normal to the polar tetragonal axis are similarly reduced, but along the polar direction remain unchanged. (auth)

21857 EFFECT OF THE DEGREE OF GRAPHITIZATION OF A CARBON MATERIAL ON THE CHANGE IN MAGNETORESISTIVE EFFECTS DURING NEUTRON IRRADIATION. Polozhikhin, A. I.; Virgil'ev, Yu. S.; Kotosonov, A. S.; Efremova, G. F.; Kalyagina, I. P. Sov. At. Energy (Engl. Transl.); 35: No. 3, 855-857(Sep 1973).

Translated from At. Energ. (USSR); 35: No. 3, 207-208(Sep 1973).

The magnetoresistance of the irradiated samples dropped to zero, but the Hall coefficient (R_x) became positive. The dependence of R_x and specific electric resistance (φ) for the irradiated samples on the temperature of the preliminary processing is shown graphically. Measurements at 300 and 77°K showed that

the R_x for the irradiated samples does not depend on the temperature of the measurement, i.e., the free charge carriers are found in a degenerated state. In this case, the concentration of the hole charge carriers can be calculated. It was found to be greater than the concentration of the normal charge carriers in the original samples. The extraordinary drop in the electric conductivity after irradiation of poorly graphitized samples is connected with this increase in the concentration of the charge carriers, but the changes in the rest of the characteristics determining ρ (the material's density and the charge carriers' mobility) for poorly graphitized samples were found to be less important. The calculations also showed that the number of extra holes created by the irradiation decreases with an increase in the degree of structural perfection of the original samples. Thus, in a sample processed at 1500°C, the concentration of holes after irradiation is 12.7×10^{20} cm^{-3}, but at 3000°C it is 4.4×10^{20} cm^{-3}. Layer defects (vacancies and their aggregates), having developed during irradiation, are also found in the same proportion. Under prescribed irradiation conditions when intermediate atoms and their aggregates are primarily mobile, annealing occurs due to migration to sinks (crystal boundaries) and annihilation by vacancies. In this case, the large mobility of intermediate atoms in samples with a large degree of perfection of crystalline structure contributes to the healing of a large number of vacancies that correspondingly reduces the concentration of extra holes. However, the entire situation and the final result can be essentially changed, if irradiation temperatures are elevated when the vacancies become mobile. (auth)

21858 GENERATION OF SLIP BY PRESSURIZATION OF LiF SINGLE CRYSTALS CONTAINING CAVITIES. Evans, R. A.; Wronski, A. S.; Redfern, B. A. W. (Bradford Univ., Eng.). Phil. Mag.; 29: No. 6, 1381-1398(Jun 1974).

Single crystals of LiF containing cubical and near-spherical cavities were subjected to hydrostatic pressures of up to 1.5GNm^{-2} and the resultant microstructural changes were studied using the repeated etching technique. Nucleation of dislocations in the vicinities of the holes was observed to result from treatments above a threshold pressure characteristic of the cavity size. On raising the pressure, further dislocations were generated. These arrays were on the twelve $\langle 110 \rangle \{110\}$ slip systems, each being associated with a cavity edge for the case of cubical cavities. An adequate representation of a first glissile half-loop is by the introduction of "an extra (110) half plane" connecting the distorted (010) cavity face with the (110) slip plane. The (110) plane is bounded by a glissile edge dislocation in (110) and sessile edge dislocations in (001) terminating at the cavity. By symmetry, twelve pairs of $\langle 110 \rangle \{110\}$ half-loops can be produced and the process may continue to generate further slip. The dislocation behavior in the pressure-induced arrays resembles that in conventional slip bands. Dislocation interactions and the pressure-dependent probability of cross-slip events are thought to contribute to the stability and the ultimate arrangement of the dislocation structures. (auth)

21859 OSCILLATING STRUCTURE OF LOW-TEMPERATURE LUMINESCENCE SPECTRA OF URANYL TRINITRATE CRYSTALS. Volod'ko, L. V.; Komyak, A. I.; Vitkovskii, G. P.; Sleptsov, S. E. Zh. Prikl. Spektrosk.; 20: No. 4, 634-638(Apr 1974). (In Russian).

The luminescence spectra of isomorphous uranyl trinitrate crystals were measured at 4.2°K. Based on the results obtained and on calculated data for infrared absorption and other spectra, the oscillations in the luminescence spectra were referenced. Special features of the oscillating structure of the spectra were studied, and the shapes and widths of the leading lines were examined. (tr-auth)

21860 PHOTOLUMINESCENCE OF LiD ACTIVATED BY Hg-LIKE IONS. Cholakh, S. O.; Gabrilov, F. F.; Slevarev, A. I.; Terent'ev, G. I.; Shul'gik, B. V.; Kriklivii, Yu. M. Zh. Prikl. Spektrosk.; 20: No. 4, 722-742(Apr 1974). (In Russian).

LiD was activated by the Hg-like ions Ge^{2+}, Sn^{2+}, Bi^{3+}, and Sb^{3+} and may be referred to the alkali halide phosphors. The luminescence and activation spectra of LiD were studied at 78 and 300°K, and compared with the analogous spectra of LiH phosphors. The LiD luminescence spectra had maxima at 608 (Ge), 605 (Sn), 530 (Bi), and 490 (Sb) nm. In the activation of Bi^{3+} and Sb^{3+} the light is related to the $^3p_1 - {}^1s_0$ transition in the activator ions. Individuality of the Ge^{2+} and Sn^{2+} ions does not appear in the luminescence and activation spectra of LiD, and the observed light is related to the defects around the activator. The isotopic effect on spectrum properties of LiD and LiH phosphors is not large. (tr-auth)

21861 ION IMPLANTATION. Dearnaley, G. (Atomic Energy Research Establishment, Harwell, Eng.). Annu. Rev. Mater. Sci.; 4: 93-123(1974).

Ion implantation is examined as a general technique in materials science. Ion ranges, ion-induced radiation damage, and applications to semiconductors, metals, optical materials, superconductors, and magnetic materials are discussed. Finally, equipment for ion implantation is described. (17 figures, 74 references) (DLC)

21862 ACOUSTIC PROPERTIES OF β-RHOMBOHEDRAL BORON. Silvestrova, I. M. (Inst. of Crystallography, Moscow); Belayev, L. M.; Pisarevski, Y. V.; Niemyski, T. Mater. Res. Bull.; 9: No. 8, 1101-1106(Aug 1974).

Ultrasonic absorption was measured in β-rhombohedral boron over a frequency range of 0.4 to 1.4 GHz at room temperature. The absorption of longitudinal waves in boron is found to be the lowest of all values known to date in other materials. The sound speed was measured and the elastic constants were calculated in β-boron. (auth)

21863 DISRUPTION OF THE GREEN RADIATION OF $^{3+}$Tb-ACTIVATED GLASS BY AN ELECTRON BEAM. Arifov, U. A.; Bedilov, M. R.; Saidov, R. (Inst. of Electronics, Tashkent). Dokl. Akad. Nauk Uzb. SSR; No. 11, 21-22(1973). (In Russian).

Oscillogram data on disruption of the green radiation of terbium-activated glass under the influence of an electron beam indicated that the interaction and transfer of energy of charged particles to an optically transparent body with positively charged activators is a complex process. The breaking of the radiation into two or three pulses cannot be explained by temperature or dosage effects or by changes in the transparency of the irradiated sample. It may be due to the nature of the interaction of the current of negatively charged particles with the excited terbium ions at the metastable level. (TTT)

NUCLEAR MATERIALS AND WASTE MANAGEMENT

Accountability and Safeguards

Refer also to abstracts 20583 and 20657.

21864 (BNL-18969) METHOD TO DETERMINE THE MINIMUM COST MEASUREMENT PLAN CONSISTENT WITH ANY FEASIBLE LIMIT OF ERROR ON MUF. Indusi, J. P.; Marcuse, W. (Brookhaven National Lab., Upton, N. Y. (USA)). 4 Jun 1974. 19p. (CONF-740622-8). Dep. NTIS $4.00.

From meeting of institute of nuclear materials management; Atlanta, Georgia, USA (19 Jun 1974).

Measured values for all flow and inventory quantities are required for nuclear materials safeguards and are necessary for nuclear materials control. The quality (accuracy and precision) of these measured values provide the basis for a standard for material control. A prerequisite to establishing this standard is that the streams or strata measured should be identified as to typical batch sizes and associated measurement errors. The measurements may be made by sampling and analysis or by nondestructive assay techniques. Each sampling and analysis technique has random and systematic errors associated with the bulk measurement, the sample, and the analysis. Each non-destructive assay technique also has a random and systematic error associated with it. Consequently, a vast number of measurement strategies are available for measuring feed, product, discard, recycle and intermediate products, to generate a material balance and the error (LEMUF) associated with the balance. In addition, each bulk measurement, sample taken, and analysis has an associated cost, and hence, each measurement strategy generates a total cost. Given the cost associated with each of the measurement variables, an algorithm has been written that seeks the minimum cost solution for any feasible limit of error. Many strategies are dominated in the sense that the same LE can be attained at a lower cost or a smaller LEMUF can be achieved at the same cost. The algorithm and two examples of its application are described. (auth)

21865 (IAEA-R-1209-F) OPTIMIZATION OF SAFEGUARDS EFFORT. Final Report, 15 August 1972–14 August 1973. Avenhaus, R.; Gupta, D. (International Atomic Energy Agency, Vienna (Austria)). Nov 1973. 113p. INIS.

The application of game theory in the optimization of safeguards effort was studied with reference to a reprocessing facility and a mixed-oxide fabrication facility. The complete problem was known to be not solvable analytically; major effort was devoted to various simplifying assumptions which permitted solutions using Lagrange multipliers. Two six-month material balance periods were studied, with the inspector constrained to apply the same effort in both periods. Number of batches "diverted" and number of batches inspected were assumed to be continuous variables; both approximations proved to be quite good. The method used did not permit introduction of a boundary condition that the number of inspection samples could not exceed the number of batches; this proved troublesome. Where the inspector is concerned only with measurement uncertainty, inspector confidence is gained easily; generally the difference between 20% sampling and 100% sampling is small. Where data falsification is conceivable and batch-to-batch variations are significant, inspector confidence is gained very slowly. (INIS)

21866 (LA-5652-M) PASSIVE SEGMENTED GAMMA SCAN OPERATION MANUAL. Martin, E. R.; Jones, D. F.; Speir, L. G. (Los Alamos Scientific Lab., N. Mex. (USA)). Jul 1974. Contract W-7405-eng-36. 54p. Dep. NTIS $5.45.

An operation and maintenance manual for the new computerized segmented gamma scan instrument is presented, which describes routine assay techniques as well as theory of operation treated in sufficient depth so that an experienced assayist can make non-routine assays on a wide variety of materials and samples. In addition, complete system schematics are included, along with a complete circuit description to facilitate not only maintenance and troubleshooting but also manufacturer reproduction of the instrument if desired. Complete software system descriptions are included, although detailed listings should be obtained from LASL in order to make machine-language code changes. (auth)

21867 (LA-UR-74-794) SOME FUNNY THINGS HAPPENED ON THE WAY TO THE LIMIT OF ERROR STANDARD. Moore, R. H. (Los Alamos Scientific Lab., N. Mex. (USA)). 1974. Contract W-7405-eng-36. 10p. (CONF-740622-1). Dep. NTIS $4.00.

From meeting of institute of nuclear materials management; Altanta, Georgia, USA (19 Jun 1974).

A singular view of the concept of "limit of error" and its several interpretations with the nuclear materials industry is presented. A description and discussion of an American National Standard on limit of error concepts are included. (auth)

21868 (UCRL-51605) SIMULATION STUDY OF PLUTONIUM GAMMA RAY GROUPINGS FOR ISOTOPIC RATIO DETERMINATION. Gunnink, R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 10 Jun 1974. Contract W-7405-eng-48. 58p. Dep. NTIS $5.45.

A promising nondestructive method for measuring plutonium isotopic abundance ratios is the analysis of neighboring gamma rays in a spectral grouping whose members belong to different isotopes. A preliminary study of all such peak groupings capable of yielding this kind of information was made. This report describes the groups studied and the procedures used, and contains the results obtained using a computer program developed for predicting the ultimate levels of precision that can be obtained. (auth)

21869 ASSESSMENT OF THE ASSUMPTION OF NORMALITY (EMPLOYING INDIVIDUAL OBSERVED VALUES). New York; American National Standards Institute, Inc. (1974). 16p. (ANSI-N-15.15-1974).

This standard describes statistical hypothesis-testing techniques that are designed to assist in the assessment of the assumption of normality by making use of all the individual observed values in a sample. There is no requirement that the number of observed values be "large," nor is it required that the observations be grouped into intervals with the attendant loss of information about the intervalue spacings. The procedures are called "omnibus" because they are appropriate for detecting departures from normality caused by any of several characteristics, including skewness (nonsymmetry) and kurtosis ("peakedness"). Empirical studies have demonstrated that these procedures generally are more effective than several others in wide currency. (auth)

Disposal and Storage

Refer also to abstracts 20783, 20816, 20817, 21089, and 21178.

21870 (KFK-1862) RADIOACTIVE WASTE DISPOSAL. 1972 Annual Report. Bechthold, W.; Diefenbacher, W.; Hild, W. (Kernforschungszentrum Karlsruhe (F.R. Germany); Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Neuherberg/Muenchen (F.R. Germany)). 19 Dec 1973. 35p. (GSF-T-45). Dep. NTIS (US Sales Only) $4.75.

A survey of the work performed in 1972 on radioactive waste disposal is presented. The mining and construction work is discussed, which was carried out both underground and above ground at the Asse Salt Mine near Remlingen and which was done for repair, maintenance and expansion of operation in accordance with its future purposes. The disposal of low-level wastes on the 750 m-level was continued in the period under review. Starting September, three waste drums from the Karlsruhe Nuclear Research Center were disposed of per week in the facility for disposal of intermediate-level wastes on the 490 and 511 m-level after a successful test operation. Thus, the total amount till the end of the year was 58 drums. Moreover, information on the present status of research in the fields of rock mechanics, geology, and hydrology, and of its results is given. Also, storage techniques are discussed which are currently in the planning stage. (auth)

21871 (LA-5645) GUIDELINES FOR THE INTERIM STORAGE OF AEC-GENERATED SOLID TRANSURANIC WASTES. (Los Alamos Scientific Lab., N. Mex. (USA)). Jun 1974. Contract W-7405-eng-36. 70p. Dep. NTIS $5.45.

Guidelines have been developed to provide a basis against which to judge the adequacy of techniques and methods for the retrievable storage of AEC-generated transuranic-contaminated solid wastes. These guidelines apply to operations for packaging, handling, and storage of such wastes. Each guideline has been fully discussed with emphasis on the reasoning behind the guideline statement, problems that should be considered in developing a storage facility, and methods currently in use at AEC installations. (auth)

21872 WASTE MANAGEMENT IN THE NUCLEAR POWER PROGRAM. Campbell, W. M. (Atomic Energy of Canada Ltd., Chalk River, Ont.). pp Paper No. CNA'73-303 of Proceedings of the Thirteenth Annual International Conference of the Canadian Nuclear Association. Toronto; Canadian Nuclear Association (1973).

From 13th annual international conference of the Canadian Nuclear Association; Toronto, Ontario (17 Jun 1973).

Waste management for nuclear power stations at near-mature operating conditions is discussed and future predictions made using estimates for Canadian nuclear power to the year 2000. The Canadian policy favors retrievable storage as opposed to permanent irretrievable disposal as a means of keeping continuous control over the wastes indefinitely and of preserving them for a future time when fuel reprocessing would become economically feasible. Data for gaseous releases, liquid releases and non-fuel radioactive solids of the Pickering Generating Station during 1972 are given as representative of Canadian stations. Criteria for short-term and long-term storage of spent fuel are outlined, and the relative merits of the various options for long-term retrievable storage compared. (GA)

21873 1973 REPORT OF THE JAEC SPECIALISTS GROUP ON RADIOACTIVE WASTE MANAGEMENT. Ishihara, T. (Japan Atomic Energy Research Inst., Tokai). Genshiryoku Kogyo; 20: No. 1, 9-15; 38(Jan 1974). (In Japanese).

A short history of Japanese organizations and their reports on radioactive waste management is given, and the guidelines are discussed which were drawn by a committee for the disposal of solidified wastes in the sea, for storage facilities and for the safety evaluation of sea and land disposals. As for the sea disposal, a schedule for the development of solidification, investigation of marine conditions, safety analysis and international understanding, test disposal and publication of the results, and final industrial disposal (scheduled to start from 1980) is explained. Outlines of the London Convention, and the associated recent activities of IAEA and NEA are also discussed. The Japanese guidelines for cement solidification which are more precise and severe are listed together with the principal ideas of safety analysis. As for the land disposal, the guidelines for retrievable surface storage facility and underground repository are discussed. As developmental plans, PNC's pilot plants for the solidification of medium- and high-level liquid wastes are described. Other items for future development are tabulated. Especially, the general idea and cost evaluation of extraterrestrial disposal and nuclear transmutation are explored. Finally, the trend toward the establishment of a radioactive waste management center is suggested with emphasis on the importance of international control of radioactive wastes. (JA)

21874 SUPERCONDUCTIVITY CAVITY RESONATORS. Pfister, H. (Siemens A.G., Erlangen (F. R. Germany). Forschungslaboratorium). Siemens Forsch.-Entwicklungsber.; 3: No. 2, 90-99(1974). (In German).

From spring meeting of the Deutsche Physikalische Gesellschaft; Muenster, F. R. Germany (19 Mar 1973). 11 figs.; 10 tabs.; 72 refs.

Interest in HF-superconductivity increased since the fabrication of high quality superconductive cavity resonators is possible and since the utilization of such resonators in linear accelerators is discussed. Best results are obtained till now with niobium resonators. Remaining problems are the influence of material parameters and surface properties on surface resistance and magnetic breakdown, which determine the HF-losses and the attainable HF-field strength. (GE)

Transportation

21875 (BNWL-SA-5026) IMPACT ANALYSIS OF METAL CANS DAMAGED DURING A RADIOACTIVE MATERIALS SHIPMENT. Taylor, J. M. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). [nd]. 17p. (CONF-740901-13). Dep. NTIS $4.00.

From fourth international symposium on packaging and transportation of radioactive materials; Miami Beach, Florida, USA (22 Sep 1974).

The impact properties of metal cans used to package radioactive materials was determined. The study was done because metal cans of the same type were damaged during a radioactive shipment. The impact properties of the metal cans were used to estimate the impact force that was applied to the damaged metal cans. The study revealed that the damaged metal cans were subjected to considerable impact force inside a DOT-6M shipping container. Drop tests, using a metal pipe from a DOT-6M and loaded in a similar fashion as the shipment, required 1000 drops (dropping height = 3') to cause extensive damage to the cans similar to the damage incurred during shipment. Vermiculite was evaluated as a protective packaging material during drop tests. It proved to be inadequate due to its high compressibility. (auth)

21876 (CONF-740901-3) COMBINATION NEUTRON AND FIRE SHIELD. Irvine, A. R.; Shappert, L. B. (Oak Ridge National Lab., Tenn. (USA)). 1973. 13p. Dep. NTIS $4.00.

From 4th international symposium on packaging and transportation of radioactive materials; Miami Beach, Florida, USA (22 Sep 1974).

The neutron shield system consisting of a mixture of LiOH and NaOH serves to not only reduce the neutron dose rate around a shipment of spent fuel, but also to provide protection against damage of the shipment by fire. Fire protection is afforded by means of a Dewar flask type of insulation that remains effective until a predetermined cask temperature is reached, and also by means of substantially increasing the heat capacity of the cask. After the predetermined maximum cask temperature has been attained, the neutron shield system serves as a good heat conductor. Calculations indicate that a large steel-shielded cask loaded with short-delayed fuel assemblies and equipped with this type of neutron shield could readily survive a 1475°F fire of 10-hr duration. Calculations are, in part, confirmed by experimental results. (auth)

21877 (CONF-740901-4) DESIGNING PACKAGES FOR SHIPMENTS OF SOLUTIONS CONTAINING ^{239}Pu AND ^{233}U. Ulrich, W. C. (Oak Ridge National Lab., Tenn. (USA)). 1974. 14p. Dep. NTIS $4.00.

From 4th international symposium on packaging and transportation of radioactive materials; Miami Beach, Florida, USA (22 Sep 1974).

Designing packages to be used for the shipment of solutions containing ^{239}Pu and ^{233}U involves solving problems normally encountered in the design of packages for shipping other forms of radioactive material, such as those related to heat transfer, shielding, and criticality. Additional factors which must be considered are potentially high generation rates of radiolytic gases with attendant pressure buildup and hydrogen-oxygen reaction possibilities, material compatibility, and operational requirements. This paper discusses these problems in terms of their effects on the design of packages for shipping plutonium nitrate and uranyl nitrate solutions and describes a concept for an improved package capable of solving them. (auth)

21878 (CONF-740901-5) TRENDS AND PROJECTED SHIPMENTS IN THE NUCLEAR FUEL CYCLE INDUSTRY TO THE YEAR 2000. Blomeke, J. O.; Nichols, J. P.; Salmon, R. (Oak Ridge National Lab., Tenn. (USA)). 1974. 23p. Dep. NTIS $4.25.

From 4th international symposium on packaging and transportation of radioactive materials; Miami Beach, Florida, USA (22 Sep 1974).

Some projections for the nuclear fule industry are presented with emphasis on shipments of fuel, plutonium, and various types of wastes. The projections are based on the AEC's "most likely" forecast of the growth of nuclear power as shown in WASH-1139(72). This paper gives a brief summary of the detailed results, which are reported in ORNL-TM-3965 of February 1974. (auth)

21879 (CONF-740901-6) EXPERIMENTAL STUDY OF THE STRESS-STRAIN PROPERTIES OF CASK MATERIALS UNDER SPECIFIED IMPACT CONDITIONS. Evans, J. H. (Oak Ridge National Lab., Tenn. (USA)). [nd]. 41p. Dep. NTIS $4.00.

From 4th international symposium on packaging and transportation of radioactive materials; Miami Beach, Florida, USA (22 Sep 1974).

A study was undertaken to experimentally determine the plastic dynamic compressive stress-strain characteristics of mild steel and stainless steel for strains up to 0.5 in./in. The specimen was placed on a load cell and impacted with a free falling weight. The force-time data was obtained from the specimens using a special data acquisition system. A digital computer program was used to calculate the engineering stress and strain for all data points. When the dynamic stress-strain properties are compared with static and quasi-static properties, both materials exhibit a significant increase in strength. (auth)

21880 (DP-MS-74-44) THERMAL AND IMPACT TESTS RELATED TO SHIPPING CONTAINERS. Langhaar, J. W. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). 1974. 23p. (CONF-740901-11). Dep. NTIS $4.25.

From fourth international symposium on packaging and transportation of radioactive materials; Miami Beach, Florida, USA (22 Sep 1974).

Progress to date is described for four current test programs relating to Type B shipping containers: (1) impact and fire resistance of the Savannah River version of the LLD-1 container for shipping plutonium-239 buttons; (2) leaktightness of closures with several different gasket materials when subjected to high

temperatures for times up to two hours; (3) impact tests of an inner container of about 15 cm diameter, intended to remain leaktight after "special form" tests; and (4) impact tests of small scale models of a long slender container when dropped at small angles with the horizontal, and comparison with calculations based on rigid body dynamics. (auth)

21881 (KY-G-262) QUALITY ASSURANCE IN THE "PADUCAH TIGER" PROCUREMENT. Stitt, D. H. (Paducah Gaseous Diffusion Plant, Ky. (USA)). 24 Jun 1974. Contract W-7405-eng-26. 18p. (CONF-740901-14). Dep. NTIS $4.00.

From 4th international symposium on packaging and transportation of radioactive materials; Miami Beach, Florida, USA (22 Sep 1974).

The Paducah Gaseous Diffusion Plant ships its product (UF_6 enriched to more than 1% 235-U assay) in 10-ton steel cylinders which are protected by a type "B" polyurethane foam and steel overpack—the "Paducah Tiger." The overpack was designed by a packaging firm on subcontract to the Paducah Plant. Included in the subcontract were requirements for testing and licensing per AEC Manual, Chapter 0529, for Type "B" packages. Subsequently, four of these overpacks were purchased from the firm that designed them. Two years after that, in 1973, procurement was initiated to obtain 28 additional overpacks to the standards of AECM-0529 and AECM-5201 through standard bidding procedures. The activities associated with this procurement resulted in a very successful project that included an extensive formal QA program. Problems associated with the integration of QA, engineering, procurement, and fabrication are highlighted. (auth)

21882 (KY-G-263) RAIL SYSTEM FOR SAFE TRANSPORT OF ENRICHED URANIUM HEXAFLUORIDE IN LARGE CYLINDERS. Clifford, C. B.; Freeman, A. T.; Lawson, J. R. (Paducah Gaseous Diffusion Plant, Ky. (USA)). 1974. Contract W-7405-eng-26. 22p. (CONF-740901-10). Dep. NTIS $4.25.

From fourth international symposium on packaging and transportation of radioactive materials; Miami Beach, Florida, USA (22 Sep 1974).

The highlights of a series of rail car impact tests conducted to develop the design criteria for modifying ATMX weapons cars to transport 10-ton UF_6 cylinders in Type "B" protective packages, or 10 or 14-ton UF_6 cylinders on saddles are presented. The results of the Association of American Railroads (AAR) impact tests, made to evaluate the car and loading system for over the road service, are also presented. Based on these tests, ten ATMX rail cars were modified to transport large UF_6 cylinders within the AEC gaseous diffusion complex. (auth)

21883 (LA-4686-MS(Suppl.)) SHIELDED SHIPPING CONTAINER FOR FISSILE MATERIAL CLASS 1 OR LARGE QUANTITIES OF RADIOACTIVE MATERIAL, SUPPLEMENT. Noyes, H. E. (Los Alamos Scientific Lab., N. Mex. (USA)). Mar 1974. Contract W-7405-eng-36. 16p. Dep. NTIS $4.00.

A small, well-shielded shipping container was designed to accommodate whole or sectioned irradiated fast reactor fuel elements and associated hardware and components in compliance with existing regulatory requirements, and is reported in LA-4686-MS. This supplement expands and clarifies the detail in that report, and includes the appropriate AEC certification of conformance under current requirements. (auth)

21884 (LA-5589-MS) SHIPPING CONTAINER FOR PLUTONIUM-238 AS FISSILE MATERIAL CLASS 1. Noyes, H. E. (Los Alamos Scientific Lab., N. Mex. (USA)). May 1974. Contract W-7405-eng-36. 40p. Dep. NTIS $4.00.

The stainless steel shipping container is a small, right cylindrical assembly approximately 46 cm in diameter and 50 cm high, weighing approximately 91 kg. Access to the inner container is through a series of bolted flanges. The source material within the inner cavity must be doubly encapsulated. The contents must not exceed 720 g plutonium (oxide or metal), or be so reduced in quantity so as to not exceed the legally applicable external radiation limits at contact and at 1 m. (auth)

21885 (NLCO-1107) SAFETY ANALYSIS REPORT FOR PACKAGING STEEL BANDED WOODEN SHIPPING CONTAINERS FOR SLIGHTLY ENRICHED URANIUM METAL. Dunaway, D. L. (National Lead Co. of Ohio, Cincinnati (USA)). Jul 1974. Contract AT(30-1)-1156. 34p. Dep. NTIS $4.00.

A family of steel-banded wooden shipping containers has been used by the National Lead Company of Ohio (NLO) for Fissile Class III shipments of unirradiated uranium metal billets, ingots, and fuel cores, slightly enriched in ^{235}U. The authority for use of these containers was DOT-SP-5467. NLO is using these containers only for the shipment of ingots; but they are also being used by other AEC contractors for shipping metal pieces originally fabricated by NLO. Three types of wooden shipping containers have been used. Boxes with lids were used primarily for fuel cores but may be used for billets and ingots. Pallets with covers are used for billets and pallets without covers are used for ingots. All are banded with 1.25 inch × 0.035 inch steel strapping, secured by notched seals. Design specifications and a safety analysis of the containers are presented. (TFD)

21886 (SLA-74-5371) QUANTITATIVE CHARACTERIZATION OF THE ENVIRONMENT EXPERIENCED BY CARGO IN MOTOR CARRIER ACCIDENTS. Foley, J. T.; Hartman, W. F.; Larson, D. W.; Clarke, R. K. (Sandia Labs., Albuquerque, N. Mex. (USA)). [nd]. 14p. Dep. NTIS $4.00.

Highlights and conclusions from a detailed study (SLA-74-0002) which was performed to determine the severity of motor carrier accidents are presented. The analysis is based upon accident rates reported for intercity shipments of property by Class I and II Interstate Motor Carriers. (TFD)

21887 (SLA-74-5372) QUANTITATIVE CHARACTERIZATION OF THE ENVIRONMENT EXPERIENCED BY CARGO IN AIRCRAFT ACCIDENTS. Clarke, R. K.; Foley, J. T.; Hartman, W. F.; Larson, D. W. (Sandia Labs., Albuquerque, N. Mex. (USA)). [nd]. 7p. (CONF-740901-8). Dep. NTIS $4.00.

From fourth international symposium on packaging and transportation of radioactive materials; Miami Beach, Florida, USA (22 Sep 1974).

Relative to surface transportation modes, the frequency of occurrence of cargo aircraft accidents is about two orders of magnitude less on a mileage basis. These accidents tend to be much more severe when they do occur, however, and the purpose of the study described here is to determine how frequently the environments of the various severities can be expected. The type of environments, the parameters used to describe the several environments, and the general analytical method employed to arrive at these descriptions are those described in the previous paper. The work which is presented here is described in much greater detail in SLA-70-0001. (auth)

21888 (SLA-74-5373) QUANTITATIVE CHARACTERIZATION OF THE ENVIRONMENT EXPERIENCED BY CARGO IN RAILROAD ACCIDENTS. Larson, D. W.; Clarke, R. K.; Foley, J. T.; Hartman, W. F. (Sandia Labs., Albuquerque, N. Mex. (USA)). [nd]. 22p. (CONF-740901-12). Dep. NTIS $4.25.

From fourth international symposium on packaging and transportation of radioactive materials; Miami Beach, Florida, USA (22 Sep 1974).

A quantitative description of the frequency and severity of train accidents is a necessary prerequisite to determining the packaging requirements for safe transport of hazardous materials by rail. The purpose of this study was to provide a probabilistic description of the environments which can be expected in railroad accidents. Although it is not possible to predict the exact details of any particular accident or group of accidents, reasonable and useful approximations of the expected environment are possible using data evaluation, engineering approximations, and analytical models. The work which is presented is described in much greater detail in SLA-74-0003. (auth)

21889 (Y-DD-153) SAFETY ANALYSIS REPORT FOR PACKAGING (OAK RIDGE Y-12 PLANT MODEL DT-5 PACKAGE FOR ENRICHED URANIUM). Dyer, H. R (Oak Ridge Y-12 Plant, Tenn. (USA)). Jul 1974. Contract W-7405-eng-26. 27p. Dep. NTIS $4.00.

An evaluation was made of the Y-12 Model DT-5 shipping container for unirradiated enriched uranium metal, to demonstrate its compliance with federal regulations governing the interstate transportation of fissile materials. Destructive testing and engineering evaluations were made to demonstrate the structural integrity and thermal resistance of the package in meeting the physical testing requirements described in the AEC regulations. The KENO computer code was used to analyze the criticality safety of the package containing uranium metal and compounds of any ^{235}U isotopic enrichment. Results of this evaluation show that the package complies with all applicable regulations. (auth)

PARTICLE ACCELERATORS

Design, Development, and Operation

Refer also to abstracts 22225, 22266, 22783, 22991, and 22992.

21890 (ANL/HEP-7441) MONOENERGETIC POLARIZED NEUTRON BEAM AT THE ZGS. Meyer, W. T. (Argonne National Lab., Ill. (USA)). Jul 1974. 24p. Dep. NTIS $4.25.

The feasibility of a monoenergetic polarized neutron beam produced by the dissociation of polarized deuterons from the Argonne ZGS was investigated. Intensities on the order of 10^5 neutrons per pulse with polarizations of 50% seem achievable, based on calculations of Coulomb photodisintegration using a Weizsaecker-Williams approximation. Several plans for realizing such a beam are presented. (auth)

21891 (COO-1760-7) SUMMARY REPORT ON CYCLOTRON UTILIZATION, OPERATIONAL ACHIEVEMENTS, AND IMPROVEMENTS DURING TWELVE MONTHS ENDING MAY 31, 1974. Technical Progress Report. (Washington Univ., St. Louis, Mo. (USA)). 15 Jul 1974. Contract AT(11-1)-1760. 42p. Dep. NTIS $5.25.

A summary of operations and accomplishments for the Washington University Cyclotron Laboratory is given. Operating schedules and actual use tables are included. (WHK)

21892 (INIS-MF-1168-2, pp vp, 33p) WHAT CAN BE DONE WITH A SMALL ACCELERATOR? Hjorth, S. A. (Research Inst. for Physics, Stockholm). 1973.

From Finnish summer school in nuclear physics; Liperi, Finland (11 June 1973).

A survey of various applications of small accelerators is given. Topics include nuclear physics research, atomic and molecular research, crystal physics research, and medical research. (WHK)

21893 (KFK-1899, pp 107-127) EXPERIENCE IN ROOM AND EXHAUST AIR MONITORING AT HIGH-ENERGY ACCELERATORS. Baarli, J. (CERN, Geneva). Mar 1974.

The radiation hazard from air and aerosol radioactivity at the CERN accelerator installations is discussed. Studies of the air and aerosol radioactivity produced by the CERN high energy accelerators show that substantial concentrations of relatively short-lived isotopes are produced. Normally the risk from ambient γ and β radioactivity in machine parts is the dominant hazard for repair and maintenance work on the accelerators. With respect to the release of radioactivity into the environment it is shown that the specific activity is about 2 or more orders of magnitude lower than the $(MPC)_a$ for the population at large. In addition, contamination of the environment seems to be limited to ^{7}Be and ^{3}H. For ^{7}Be the concentrations will be comparable to those produced by cosmic rays and would consequently be difficult to measure. This has been confirmed by studies of air and aerosol radioactivity near the accelerators where no correlation could be made of this radioactivity to accelerator operation. However, the problem will have to be followed up in the future due to the increased intensity which is planned for the CERN 600 MeV SC and 28 GeV PS. (auth)

21894 (KFK-1899, pp 129-140) EXPERIENCES IN THE SPACE AND AIR MONITORING AT LOW-ENERGY PARTICLE ACCELERATORS. Sauermann, P. F. (Kernforschungsanlage, Juelich, Ger.). Mar 1974. (In German).

The measurements made and results obtained for the space and air monitoring carried out at the electron accelerator, the ion accelerator (cyclotron), and the 15-MeV neutron generator are reviewed. The results are tabulated and only in the case of ^{41}Ar was the MPC exceeded. Some results of tritium emission and immission measurements made on the neutron generator (which has a tritium target) were indicated. (JSR)

21895 (LBL-2490) ELECTRON RING PROGRAM AT LAWRENCE BERKELEY LABORATORY. Chupp, W. W.; Faltens, A.; Hartwig, E. C. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). May 1974. Contract W-7405-eng-48. 6p. (CONF-740522-29). Dep. NTIS $4.00.

From 9th international conference on high energy accelerators; Stanford, California, USA (2 May 1974).

The LBL Electron Ring Program has demonstrated the injection and efficient trapping of rings of 7×10^{12} electrons without significant losses or dimensional broadening due to instabilities. The instabilities have been identified and either eliminated or ameliorated to the extent that their effects are acceptable. Most of the ring initially trapped can be compressed to a radius of 4 cm. The radial width of the rings show the expected adiabatic damping but the axial width shows blow-up caused by resonances. The next stages, ion loading and magnetic expansion, are ready to be undertaken except for the requisite vacuum of less than 10^{-9} torr. Because of funding limitations, the Berkeley Electron Ring Program will be suspended after June 1974. (auth)

21896 (NP-20044) IPCR CYCLOTRON PROGRESS REPORT, 1973. Volume 7. (Institute of Physical and Chemical Research, Wako, Saitama (Japan)). Dec 1973. 172p. Dep. NTIS (US Sales Only) $11.75.

This volume contains recent information on the IPCR Cyclotron and informal reports of research done at the Institute of Physical and Chemical Research. Sections of the report have the following headings: machine operation, machine development and accelerator physics, nuclear physics: scattering and reactions, nuclear physics: nuclear spectroscopy, nuclear instrumentation, atomic and solid-state physics, radiochemistry, radiation chemistry and radiation biology, preparation of radioisotopes and labeled compounds, radiation monitoring, and a new machine. Lists of publications, personnel, and outside users and their work are also included. Nineteen of the papers in this report are separately title listed. (RWR)

For title listings of individual papers see: 20746, 20747, 21346, 21347, 21663, 22181, 22182, 22627–22629, 22685–22687, 22744, and 22817–22821.

21897 ACCELERATOR AND ITS APPLICATION. Shen, T. S. K'o Hsueh Shih Yen; No. 1, 12-14(Jan 1974). (In Chinese).

The theoretical and practical development of the nuclear accelerator is discussed. As an introduction, the construction and operational principles of the earlier accelerators such as high-voltage multiplier, the electrostatic accelerator are summarized. The operation of the modern "harmonic accelerator" which includes the cyclotron, the linear accelerator, are described in detail. The classification of accelerators into low-energy, medium-energy, and high-energy devices is introduced. Some examples of accelerator applications are also presented; they include: (1) detection of internal defects in materials, (2) production of semiconductors, (3) treatment of cancer and (4) genetic research of plants. (JPRS)

Auxiliaries and Components

Refer also to abstract 22605.

21898 (ANL-Trans-956) rf LOSSES IN SUPERCONDUCTING HELIX RESONATORS (APPROX. = 100 MHz RANGE) CAUSED BY FROZEN-IN MAGNETIC FIELD. Piosczyk, B. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Experimentelle Kernphysik). Jul 1974. Translation by A. H. Jaffey of IEKP II/III. Report 73-3-LIN. 28p. Dep. NTIS $4.50.

The added surface resistivity R_H caused by frozen-in magnetic flux in the 100-MHz regions show a complex behavior compared to that in the GHz-range. It is observed to have a stronger temperature-dependence and an increase of R_H with increasing rf-field intensity. The field intensity-dependent term of R_H may be caused by motion of the frozen-in flux tubes in the rf field. The increase of R_H with increasing rf-field intensity requires that when high rf-field intensities are used, better magnetic shielding be employed than is necessary for measurements with low rf-intensities. For a helix structure (f ≃ 90 MHz operating in an unshielded earth's field (≈0.5 Gauss), the added surface resistivity R_H (T = 1.4 K, $H_P \simeq 500$ Gauss) $\simeq 2-3 \cdot 10^{-6}\Omega$, the corresponding quality factor $Q_H = G/R_H$ amounts to about 2 (10^8). (auth)

21899 (BNL-19033) SOME REMARKS ON COLD BORE VACUUM SYSTEMS. Halama, H. J.; Bittner, J. W. (Brookhaven National Lab., Upton, N. Y. (USA)). 31 May 1974. 11p. Dep. NTIS $4.00.

In storage rings employing superconducting magnets, the use of their cold bores as cryopumps looks at first very attractive. A possible design of a cold vacuum system is therefore discussed in some detail with its theoretical and practical limitations. The comparison with ISABELLE vacuum system reveals that in a large practical machine the warm approach is superior. Relative disadvantages of the cold and warm systems are summarized. (auth)

21900 (BNL-19042) RANDOM ERROR MULTIPOLES IN SUPERCONDUCTING COSINE AND WINDOW-FRAME DIPOLES. Parzen, G. (Brookhaven National Lab., Upton, N. Y. (USA)). 28 Jun 1974. 4p. Dep. NTIS $4.00.

The random error multipoles in the median plane magnetic

field, as measured in the two superconducting 8 cm cosine magnets, ISA I and ISA II, and in the two 8° bend superconducting window-frame magnets, are compared with each other and with the results of theoretical calculations. (auth)

21901 (JINR-D13-7616, pp 11-22) INSTRUMENT FOR THE STUDY OF THE BEHAVIOR OF THE ELECTRON BEAM IN THE ADGEZATOR OF THE COLLECTIVE ACCELERATOR OPERATING ON-LINE WITH A COMPUTER. Bespalova, T. V.; Golutvin, I. A.; Golovin, V. M. (Joint Inst. for Nuclear Research, Dubna, USSR). 1974. (In Russian).

From seventh international symposium on nuclear electronics; Budapest, Hungary (17 Sep 1973).

An installation, designed for study of the behavior of the electron beam in the Adgezator of the collective accelerator in the first cycle and in the capture regime, operating on line with a computer is described. A simplified diagram of the Adgezator showing the placement of the detector part of the installation is given. The electronic recording apparatus is described, and the characteristics of the installation are tabulated. The program for data processing is outlined. (JSR)

21902 (JINR-D13-7616, pp 84-86) INSTALLATION FOR THE MEASUREMENTS OF THE PULSE PARAMETERS BASED ON THE TRA-1001 COMPUTER. Kazanskii, G. S.; Kolpakov, I. F.; Kryachko, A. P.; Nikityuk, N. M.; Susova, G. M.; Khoshenko, A. A. (Joint Inst. for Nuclear Research, Dubna, USSR). 1974. (In Russian).

From seventh international symposium on nuclear electronics; Budapest, Hungary (17 Sep 1973).

An installation designed for the acquisition and processing of data transmitted in analog form from transducers placed in the accelerator is described. The installation consists of two crates. One crate is connected with the computer through programmed channels and the other crate exchanges data with the computer through direct access channels. The operation of the CAMAC installation is briefly described. (tr-auth)

21903 (JINR-P16-7958) RADIATION SHIELDING AND RADIATION FIELDS AROUND A SYNCHROPHASOTRON AT SLOW PROTON EXTRACTION. Antipyuk, A. I.; Getmanov, V. B.; Bushuev, I. I.; Zaitsev, L. N.; Issinskii, I. B.; Kirillov, A. D.; Mal'kov, V. V.; Sidorin, V. P.; Frolov, V. V.; Khvostov, V. B. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1974. 15p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

The characteristics are presented for a shielding complex in a measurement hall of a synchrophasotron providing a normal operation of a slow extraction system. The results of the calculation of the radiation field around an accelerator agree well with experimental data. (auth)

21904 (RL-74-052) DESIGN STUDY FOR BEAM LINE DIPOLES (SUPERCONDUCTING). McInturff, A. D. (Science Research Council, Chilton (UK). Rutherford Lab.). Apr 1974. 31p. Dep. NTIS (US Sales Only) $4.75.

The design study was undertaken to find the simplest efficient iron shielded conductor configuration which would serve as a 6.0 Tesla 10 cm aperture beam line dipole element. The design calculations are done with the "on line" design program "GFUN" at the Rutherford Laboratory. Magnet design options and limits of acceptable performances are stated, and designs that were considered are summarized, with discussion and conclusions. (UK)

21905 (RL-74-055) NEW INJECTOR FOR NIMROD BEAM DIAGNOSTICS. Energy Ramping Measurements. Swales, F. J. (Science Research Council, Chilton (UK). Rutherford Lab.). Mar 1974. 4p. Dep. NTIS (US Sales Only) $4.00.

A phase ramp of ±1 radian has been selected for the de-buncher operation on the new 70 MeV Injector Beam for NIMROD and this will result in a value for the energy ramp of 1.09 MeV. The sector magnet used in the beam transfer line may be operated as a spectrometer with a resolution of 0.03% momentum and this spectrometer will be used in the measurement of beam energy and energy widths. It was suggested that the provision of a "time versus position" detector in the spectrometer focal plane would allow the derivation of a simple display of momentum (or energy) versus time. The characteristics of a detector system using a multi-wire profile monitor for beam detection is described in the present note. (UK)

Ion Sources and Injection and Extraction Systems

21906 (AED-Conf-74-042-002) R. F. ION SOURCE FOR NEGATIVE HYDROGEN IONS. Bentz, E.; Clausnitzer, G.; Guenzl, J.; Salzborn, E. 1974. 5p. (In German). INIS.

From spring meeting of the expert committee on nuclear and high-energy physics of the Deutsche Physikalische Gesellschaft e.V.; Bochum, F. R. Germany (4 Mar 1974).

6 figs.

A reliable ion source for unpolarized H^- ions has been built for the Giessen 1.2 MeV tandem accelerator in addition to the polarized ion source according to the Lamb shift method. This source is based on the design of an R. F. source yielding a 5 mA H^+-current and has been especially designed for the production of H^- ions (charge exchange capacity H^-/H^+ of about 1% at a proton energy of 7 keV). No gas target is required for this method, which simplifies the vacuum system. The equipment itself and first measuring results are reported, namely data on the H^--current (μA) as a function of channel length (25 to 45 mm), high-vacuum pressure (0.5 to 2.0×10^{-5} torr), magnetic current and emitter efficiency. (GE)

21907 (UCID-15893) FORMATION OF A D^- BEAM FOR EFFICIENT PRODUCTION OF D^0 AT HIGH ENERGIES. Osher, J. E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 18 Aug 1971. Contract W-7405-eng-48. 12p. Dep. NTIS $4.00.

The problem of efficient formation of a D^0 beam at energies ≥100 keV is one of choosing the best of several different approaches. Riviere and Sweetman have made a study of D^0 formation in the range of 100 keV to 1 MeV using D^+, D_2^+, D_3^+ and D^- in various charge exchange media (including plasmas). Their predictions are shown. Clearly D^-, with a conversion efficiency of up to 85% has a substantial advantage if a beam of sufficient intensity can be produced. The point of this document is to outline one approach using D^+ ions at 1.5 keV passing through a series of Cs stripping cells for D^- production. Schlachter et al., have shown 21 ± 4% D^- formation ($F_-^=$ in a single cell. The details here are concerned largely with an estimate of scattering losses for the needed cell thickness and a calculation of the further enhancement that might be expected from a number of cells in cascade. The net D^- beam emittance could then be matched to the acceptance of a suitable accelerator column. After acceleration to the desired energy the beam would then be passed through a stripping cell to attain the intense beam of high energy D^0. (auth)

21908 ACCELERATION OF LASER-PLASMA IONS WITH THE PREINJECTOR OF THE JINR LINEAR PROTON SYNCHROTRON. Anan'in, O. B.; Baldin, A. M.; Beznogikh, Yu. D.; Bykovskii, Yu. A.; Zinov'ev, L. P.; Kozyrev, Yu. P. (Linear Proton Synchrotron). JETP Lett. (USSR) (Engl. Transl.); 19: No. 1, 10-12(5 Jan 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 19: No. 1, 19-23(5 Jan 1974).

The first instance of shaping and acceleration of a beam of multiply-charged ions of a laser plasma with the preinjector of the linear proton synchrotron accelerator is reported. A procedure is considered for the formation of a beam of multiply charged ions, and data are given on the flux of carbon ions at the output of the preinjector. The feasibility of developing a laser source of nuclei is indicated. (auth)

Ion Optics and Field Calculations

21909 (KFK-EXT-3/74-3) MECHANICAL EXCITATION OF SUPERCONDUCTING HELIX RESONATORS BY EXTERNAL SOURCES WITH SLOWLY CHANGING FREQUENCY. Schulze, D.; Hornung, A. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Experimentelle Kernphysik). Feb 1974. 17p. (In German). INIS.

7 figs.; 1 tab.; 26 refs. With abstract in German and English.

Helix resonators which are used for rf-acceleration of protons and heavy ions are very sensitive to mechanically induced disturbances. In particular, it is shown that sources with slowly changing frequency may lead to considerable resonant amplitudes even if the mechanical resonance is passed very fast. Thus, a substantial distortion of the operating accelerator is to be expected. A further enhancement may result if the resonance is passed several times in short intervals. This cumulation effect is particularly efficient for superconducting niobium cavities, whose mechanical damping factor at low temperatures is two orders of magnitude smaller than at room temperature. In addition to a theoretical analysis and model measurements, countermeasures are discussed. (GE)

21910 (LAL-RI-74-3) EXPERIMENTS WITH SEXTUPOLES ON THE ORSAY STORAGE RING (ACO). Petit, H. (Paris-11 Univ., 91-Orsay (France)). Apr 1974. 104p. (In French). Dep. NTIS (US Sales Only) $8.25.

Thesis.

This work first explains how the chromaticity has been cor-

rected on the storage ring ACO by means of sextupolar coils; it then describes the systematic study of the transverse instabilities versus chromaticity; for this subject the "Head Tail Effect" theory worked out by C. Pellegrini and M. Sands is presented and their conclusions are compared with the experimental results obtained on ACO. The presence of these sextupolar coils has also allowed to study the energy dispersion of a positron beam versus chromaticity and intensity, using the synchro-betatron resonances, due to the coupling between the longitudinal and the transverse motions of the particles. Experiments of beam injection in ACO with these sextupolar fields are described and compared with the results of a computer simulation. This program, which uses a matrix formalism expanded to the second order, allows the description of the particle motion during some hundreds of turns. (FR)

21911 (LBL-2488) OBSERVATIONS ON COLLECTIVE LONGITUDINAL INSTABILITIES IN ELECTRON RINGS. Faltens, A.; Lambertson, G. R.; Peterson, J. M.; Rechen, J. B. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). May 1974. Contract W-7405-eng-48. 5p. (CONF-740522-26). Dep. NTIS $4.00.

From 9th international conference on high energy accelerators; Stanford, California USA (2 May 1974).

The longitudinal collective instability, or negative-mass effect, has been observed in a wide variety of particle beams. It has been a particularly bothersome effect in electron-ring systems. In order to understand its complicated, non-linear behavior and to find means of controlling this instability, a series of radio-frequency and momentum-spread observations were made. The conclusions drawn from these studies are as follows: (1) a conducting enclosure can be designed to suppress longitudinal instability in the electron ring. Resonant responses of the enclosure appear but can be limited in strength; (2) the longitudinal instability is still a limiting but not necessarily prohibitive factor in achieving high electron density during the ring formation and start of compression. Throughout subsequent stages of the ring manipulation it is expected to require control; (3) the instability arises at many frequencies simultaneously and appears to be a non-linear phenomenon involving many coupled modes; one does not observe a threshold for bunching that follows the usual linear predictions for a smooth energy distribution. Growing modulation is seen over a wide range of conditions; and (5) even in the presence of rf activity, deterioration of ring quality is moderate until intensities exceed the expected threshold to a significant degree. There is reason to believe that the commonly-accepted intensity limitations can be achieved or exceeded. (WHK)

21912 CONTROL OF DISORDERED BEAMS OF CHARGED PARTICLES. Arifov, V. A.; Arifov, P. U.; Shevelev, S. V.; Shevchenko, A. V. (Inst. of Electronics, Tashkent). Dokl. Akad. Nauk Uzb. SSR; No. 8, 16-18(1973). (In Russian).

Elliptical and parabolic reflectors permit the use of charged-particle sources of low intensity because of the screening of particles from the large solid angle. Equations are presented which were developed in a study of the movement of charged particles (positrons, electrons, ions) in such reflector fields. (TTT)

Storage Rings

21913 (BNL-18891) PROPOSAL FOR CONSTRUCTION OF A PROTON-PROTON STORAGE ACCELERATOR FACILITY, ISABELLE. (Brookhaven National Lab., Upton, N. Y. (USA)). May 1974. 352 p. Dep. NTIS $20.75.

A proposal for the construction of a 200 × 200 GeV proton-proton Intersecting Storage Accelerator Facility is presented. Topics include physics justification for the ISA and implementation of experimental program; ISA ring structure and orbit dynamics; collective effects in the ISA; magnet and dewar system; refrigeration and liquid helium distribution system; magnet power supply; vacuum system; beam transfer and injection; rf accelerating system; control and monitoring system; fast protective ejection; ISA shielding; structures, utilities, site work, and geodetic survey; cost estimate and schedule; future options; 200-GeV ISA with conventional magnets; and a two-stage approach to ISABELLE. (WHK)

21914 (BNL-19062) EXTRAPOLATION OF THE ISABELLE DESIGN TO 400 × 400 GeV. Chasman, R.; Gluckstern, R. L. (Brookhaven National Lab., Upton, N. Y. (USA)). 27 Jun 1974. 11p. Dep. NTIS $4.00.

Consideration of a national program for the development of new high energy facilities during the next ten years suggests that the most appropriate energy for proton storage rings may be higher than the 200 × 200 GeV of the present ISABELLE design. It has been indicated that 300 × 300 GeV or 400 × 400 GeV may provide a more reasonable step to maximize the scientific potential of the next major proton storage ring facility. A preliminary analysis of the design consequences of changing the ISABELLE energy to 300 × 300 GeV and 400 × 400 GeV is given, keeping the luminosity, maximum field and most of the original design parameters unchanged. It is concluded that the ISABELLE concept can be extrapolated to 400 × 400 GeV without any unmanageable technical problems and that even higher energies seem to be feasible. (auth)

21915 (BNL-19080) DYNAMIC BEAM CLEANING BY A NONLINEAR RESONANCE. Chao, A. W.; Month, M. (Brookhaven National Lab., Upton, N. Y. (USA)). 26 Jun 1974. 9p. Dep. NTIS $4.00.

The general framework for the dynamic cleaning of a stored proton beam by passing the beam through a nonlinear resonance is developed. The limitations and advantages of this technique are discussed. The method is contrasted with physical beam scraping, which is currently in use at the CERN ISR. (auth)

21916 (JINR-D13-7616, pp 28-32) REGISTRATION SYSTEM FOR THE 2-m VEPP ON-LINE WITH THE M-6000 COMPUTER. Aul'chenko, V. M.; Baru, S. E.; Korshunov, Yu. V.; Melekhov, G. G.; Savinov, G. A.; Fominykh, V. I. 1974. (In Russian).

From seventh international symposium on nuclear electronics; Budapest, Hungary (17 Sep 1973).

A description is given of the recording system used for study of e^+e^- annihilations in the VEPP-2 opposed beams. The recording system contains a block of particle detectors consisting of a spark chamber and scintillation counter, stable fast electronics for the selection of the desired event, and stable data collectors. All apparatus is connected through the data collectors to the M-6000 minicomputer. Observations during an experiment are done by displays on storage cathode ray tubes. An installation of programmed control ensures the accuracy of all apparatus. The characteristics of the individual units are described. (tr-auth)

21917 (LBL-3016) STOCHASTICITY. Laslett, L. J. (California Univ., Berkeley (USA)). Lawrence Berkeley Lab.). May 1974. Contract W-7405-eng-48. 8p. (CONF-740522-28). Dep. NTIS $4.00.

From 9th international conference on high energy accelerators; Stanford, California, USA (2 May 1974).

Computational methods for investigating the possible development of stochastic motion in storage ring devices are briefly considered. The analysis of synchrotron oscillations for a particle in a coasting beam is discussed. (WHK)

21918 (LBL-3032) PROTON-ELECTRON-POSITRON PROJECT: PEP. Smith, L. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 17 May 1974. Contract W-7405-eng-48. 19p. (CONF-740522-27). Dep. NTIS $4.00.

From ninth international conference on high energy accelerators; Stanford, California, USA (2 May 1974).

The LBL-SLAC Joint Study Group has produced a design for an electron-positron and proton-electron or positron colliding beam facility (PEP) which will provide for electrons up to 15 GeV and protons up to 200 GeV with a luminosity of 10^{32} cm^{-2} sec^{-1} for the peak energies at six collision points. The physics justification for the electron-proton rings is summarized and the proposed facility is described. The rings will have six arcs having gross radii of about 220 meters, with the electron ring sextants alternately above and below the plane of the proton ring. Five of the interaction regions will be developed for experimental use, providing 20 meters of free space for experimental equipment about the interaction points which are at the center of insertions about 130 meters long. The design of the total facility has been considered in sufficient detail to provide a basis for, and to insure compatibility with, a first-stage facility consisting of the e^+ ring alone. A proposal for construction of this first stage had been submitted to the Atomic Energy Commission. The total concept of the project is described with particular emphasis on current ideas concerning the proton ring, which involves the new features of using superconducting magnets and maintaining a tightly bunched proton beam of high intensity. (auth)

21919 (LNF-74/16(P)) LONGITUDINAL FEEDBACK SYSTEM IN ADONE. Renieri, A.; Tazzioli, F. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 17 Apr 1974. 6p. (CONF-740522-34). Dep. NTIS (US Sales Only) $4.00.

From 9th international conference on high energy accelerators; Stanford, California, USA (2 May 1974).

The feedback system, working on Adone, that acts on the longitudinal relative modes of oscillation of the two e^+, e^- beams, of

three bunches each, is described. The stability condition for small oscillations of rigid bunches is analytically found. The system, implemented with two resonators tuned at the 8th harmonic of the revolution frequency, is described. The results are discussed. (auth)

21920 (LNF-74/17(P)) NONLINEAR BEAM–BEAM EFFECT COMPUTER SIMULATION. Renieri, A. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 17 Apr 1974. 5p. (CONF-740522-35). Dep. NTIS (US Sales Only) $4.00.

From 9th international conference on high energy accelerators; Stanford, California, USA (2 May 1974).

The motion of a single particle colliding with a strong beam in a storage ring was studied by computer simulation under the assumptions that there is no radiation noise and no damping and that the strong beam has a gaussian transverse charge distribution. The phase space regions of stochastic motion and the corresponding minimum ΔQ values are determined. There is evidence that the motion stochasticity is due to overlapping of neighboring resonances (Chirikov criterion). (auth)

21921 (LNF-74/18(P)) SUPER-ADONE ELECTRON–POSITRON STORAGE RING DESIGN. Amman, F.; Bassetti, M.; Cattoni, A. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 19 Apr 1974. 5p. (CONF-740522-30). Dep. NTIS (US Sales Only) $4.00.

From 9th international conference on high energy accelerators; Stanford, California, USA (2 May 1974).

The results of a design study for a high-energy electron-positron storage ring to be built at the Frascati National Laboratories are summarized. (auth)

21922 (LNF-74/19(P)) RESONANT METHODS FOR BEAM SIZE CONTROL IN STORAGE RINGS. Bassetti, M. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 23 Apr 1974. 5p. (CONF-740522-31). Dep. NTIS (US Sales Only) $4.00.

From 9th international conference on high energy accelerators; Stanford, California, USA (2 May 1974).

Three methods for varying the magnetic structure of a storage ring at constant betatron number Q_x, in order to vary the natural beam dimensions, are discussed. It is also shown that beam–beam interaction in the thin lens approximation, and dipole or gradient errors can be interpreted as magnetic structure modifications of the kind discussed. (auth)

21923 (LNF-74/22(P)) ADONE: PRESENT STATUS AND EXPERIMENTS. Bassetti, M.; Cattoni, A.; Chimenti, V. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 26 Apr 1974. 4p. (CONF-740522-32). Dep. NTIS (US Sales Only) $4.00.

From 9th international conference on high energy accelerators; Stanford, California, USA (2 May 1974).

The present status of the electron-positron storage ring Adone is reported, together with the foreseen improvements. Some recent measurements are also reported. (auth)

21924 (RL-74-053) LONGITUDINAL INSTABILITIES IN EPIC (e^4). Hereward, H. G. (Science Research Council, Chilton (UK). Rutherford Lab.). [nd]. 4p. (EPIC/MC-46). Dep. NTIS (US Sales Only) $4.00.

It is stated that with only two bunches (in each beam) they are far apart and long-range wake effects should be rather small for a single beam. (By long range is meant the effect of one bunch on the other or on itself on subsequent turns.) Comments are offered on different forms of instability. Single bunch instability from short range wakes is also discussed. (UK)

21925 (RL-74-054) REFERENCE NUMBERING SYSTEM FOR EPIC LATTICE COMPONENTS. Loach, B. G. (Science Research Council, Chilton (UK). Rutherford Lab.). Mar 1974. 19p. (EPIC/MC-26(Rev.1)). Dep. NTIS (US Sales Only) $4.00.

It is desirable with a machine as large and complex as EPIC to be able to refer specifically to any item in the ring lattice structure and know immediately where that item is located. A suitable numbering system has been agreed upon so that all concerned can use a common system. The system is described. (UK)

21926 (RL-74-058) VACUUM OUTGASSING IN THE ELECTRON RING OF EPIC. Bennett, J. R. J. (Science Research Council, Chilton (UK). Rutherford Lab.). Mar 1974. 8p. (EPIC/MC-47). Dep. NTIS (US Sales Only) $4.00.

Provisional calculations are presented for the evaluation of the outgassing of the vacuum chamber walls of the electron/positron storage/accelerator ring of EPIC. The outgassing is from two major sources: thermal and synchrotron radiation induced desorption. Both depend on the nature and history of the surface and bulk material of the vacuum chamber. Outgassing rates from direct photodesorption, photoelectric desorption and thermal desorption for the complete ring are estimated. A comparison is made with other machines, and conclusions are reached about the pumping capacity required to obtain a reasonably quick pump down and to maintain a pressure of 10^{-9} torr with full circulating beam. (UK)

21927 (RL-74-062) LONGITUDINAL HEAD–TAIL EFFECT BY THE BUNCH LENGTH VARIATION METHOD. Hereward, H. G. (Science Research Council, Chilton (UK). Rutherford Lab.). Apr 1974. 3p. (EPIC/MC-48). Dep. NTIS (US Sales Only) $4.00.

It is stated that a bunch making coherent dipole (barycentre) synchrotron oscillations also oscillates in length. This is examined in relation to the bunch-length-dependent energy loss and instability. The skin-effect loss was estimated for the EPIC storage ring. (UK)

21928 (RL-74-078) SCIENTIFIC CASE FOR EPIC. Manning, G.; Ringland, G.; Sekulin, R. L.; Harold, M. R.; Foster, F. (Science Research Council, Chilton (UK). Rutherford Lab.). May 1974. 46p. Dep. NTIS (US Sales Only) $5.50.

A summary of the feasibility study to assess the physics interest and practical possibilities of the EPIC e^+-e^--p storage ring is given. The EPIC machine design, e^+e^- physics with EPIC, ep physics with EPIC, and conclusions of the EPIC feasibility report are discussed. The members of the EPIC working parties are listed and papers and minutes produced by the EPIC working parties are listed. (WHK)

21929 (RL-74-083) DESIGN AND STATUS OF EPIC. Bennett, J. R. J.; Brooks, H. C.; Donald, M. H. R. (Science Research Council, Chilton (UK). Rutherford Lab.). May 1974. 9p. (CONF-740522-33). Dep. NTIS (U. S. Sales Only) $4.00.

From 9th international conference on high energy accelerators; Stanford, California, USA (2 May 1974).

The present status of the EPIC machine design is outlined. By October 1974 an improved cost estimate will be obtained for a 14-GeV electron-positron storage ring. A machine proposal will then be submitted to the Science Research Council, seeking funds to allow the ring to be built by 1981. (auth)

Experimental Facilities

Refer also to abstracts 21184, 22225, and 22300.

21930 (AED-Conf-74-089-018) MEASUREMENTS ON THE TWO FIRST 20-CELL DEFLECTOR SECTIONS FOR A SUPERCONDUCTING RF SEPARATOR. Citron, A.; Dammertz, G.; Grunder, M.; Husson, L.; Lengeler, H.; Rathgeber, E. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Experimentelle Kernphysik). 1974. 23p. INIS.

From spring meeting of the working group "solid state physics" of the Deutsche Physikalische Gesellschaft e.V.; Freudenstadt, F. R. Germany (1 Apr 1974).

10 figs.; 5 tabs.; 25 refs. With abstract. Available from ZAED. Interner Bericht Nr. 74-33-SEP.

Experimental results on two 20-cell Nb deflector sections for an S-band superconducting rf separator are given. A sequence of surface treatments including electropolishing, anodizing, and high-temperature uhv annealing allowed reproducible Q_0 values to be obtained up to 1.8×10^9 and peak magnetic fields, up to 400 Oe. This corresponds, for the working mode ($\pi/2$), to deflecting fields of 2.6 MV/m and to electric peak-fields of 14 MV/m. The peak magnetic field levels correspond to the values obtained in TM modes in simple cavities, whereas the electric peak fields are lower by about a factor of 2. A new method for localizing cells with high surface resistance in multi-cell cavities is described and has been applied successfully. It also has been tried to localize the cells where a magnetic breakdown takes place and to determine the level of the critical magnetic fields. A new type of rf joint has been used and showed a very satisfactory behavior up to the Q values and peak-fields achieved. Perturbation measurements have been performed for a large number of modes, and it is shown that the fabrication tolerances ensure a sufficient field-flatness in the $\pi/2$ mode. A review of some deflector parameters and of the measured frequency behavior under different working conditions and for different treatments is given. (auth)

21931 (INIS-MF-1168-2, pp vp, 21p) ABOUT RECOIL AND SPECTROMETER SYSTEMS SUITABLE FOR STUDIES OF HEAVY FAST RECOILS FROM NUCLEAR REACTIONS. Eskola, K. (Univ. of Helsinki). 1973.

From Finnish summer school in nuclear physics; Liperi, Finland (11 Jun 1973).

The SASSY recoil spectrometer system at the Berkeley Super-HILAC and the Redundatron recoil spectrometer proposed for UNILAC for studies of reaction products from heavy ion reactions in the search for superheavy elements are described. (WHK)

21932 (JINR-D13-7616, pp 33-39) USE OF THE NR 2116S COMPUTER FOR THE CENTER FOR THE ACQUISITION AND PROCESSING OF DATA OBTAINED IN EXPERIMENTS ON THE SYNCHROCYCLOTRON. Kazachenko, O. N.; Medved, S. V.; Sinaev, A. N.; Khan, B.; Chistov, N. A. (Joint Inst. for Nuclear Research, Dubna, USSR). 1974. (In Russian).

From seventh international symposium on nuclear electronics; Budapest, Hungary (17 Sep 1973).

Apparatus for the acquisition and processing of data from synchrocyclotron experiments is discussed. The introduction of the NR 2116S computer into this system is described. A block diagram is given of the apparatus for the acquisition and processing of data and the program for data acquisition and transmittal to the computer is outlined. (JSR)

21933 (JINR-D13-7616, pp 52-59) DATA PROCESSING SYSTEM FOR EXPERIMENTAL INVESTIGATIONS IN NUCLEAR PHYSICS. Baldauf, D.; Feigenspan, S.; Fuelle, R. 1974.

From seventh international symposium on nuclear electronics; Budapest, Hungary (17 Sep 1973).

A computer-based central data processing system being planned for the tandem generator facility at the Central Institute for Nuclear Research at Rossendorf is described. (WHK)

21934 (JINR-D13-7616, pp 70-74) APPARATUS FOR THE READOUT AND TRANSMISSION TO THE COMPUTER OF PHYSICAL DATA IN EXPERIMENTS ON THE EXTRACTED PROTON BEAM OF THE JINR SYNCHROPHASOTRON. Azhgirei, L. S.; Budkin, L. V.; Kadykova, S. V.; Kuznetsov, A. S.; Stoletov, G. D.; Filozov, A. F. (Joint Inst. for Nuclear Research, Dubna, USSR). 1974. (In Russian).

From seventh international symposium on nuclear electronics; Budapest, Hungary (17 Sep 1973).

Apparatus used in the study of the proton-nuclear scattering on the extracted beam of the synchrophasotron are described. The experimental method is based on the use of analyzing magnetic fields, scintillation counters, and wire spark chambers with ferrite memory operating on-line with a computer. A block diagram for the readout and transmission device is given. A functional diagram is presented of the system for the extraction, coding, and transmission of data from the spark chamber. (JSR)

21935 (JINR-D13-7616, pp 289-294) COUNTING SYSTEM IN THE CAMAC. Zhuravlev, N. I.; Nguen Man Shat; Sidorov, V. T.; Simaev, A. N.; Stakhin, A. A.; Churin, I. N. (Joint Inst. for Nuclear Research, Dubna, USSR). 1974. (In Russian).

From seventh international symposium on nuclear electronics; Budapest, Hungary (17 Sep 1973).

The automatic extraction of data with counters and their input into computers has been quite appropriately carried out in most CAMAC installations. Such a system, designed for use in experiments on the JINR cyclotron, is described in detail. The block diagram of the system and a block diagram of the program for the basic control regime are given. (JSR)

21936 (SLA-74-0215) BREMSSTRAHLUNG PRODUCTION ON HYDRA. Dolce, S. R. (Sandia Labs., Albuquerque, N. Mex. (USA)). Jul 1974. Contract AT(29-1)-789. 49p. Dep. NTIS $5.50.

In order to obtain a useful photon-induced energy deposition as rapidly as possible, initial experiments using the Hydra electron beam facility have been primarily directed towards development of a reliable conventional bremsstrahlung convertor. This convertor consists of a 2-mil thick layer of tantalum followed by a $\frac{1}{8}$-inch thick ATJ graphite electron stopper and a $\frac{1}{8}$-inch thick armor plate fiber glass debris catcher. The sample to be exposed is located $\frac{1}{2}$-inch from the tantalum. In this geometry, we have been able to achieve dose to 1-mil thick gold of approximately 0.40 cal/gm per kilojoule in the electron beam. While Hydra may be operated above 20 kilojoules, it has not been possible to assure sample survival at these levels because of debris catcher deformation. In addition, one type of advanced convertor has been designed and tested. This is a reentrant cone design in which an 8-inch long tantalum cone with a $3\frac{1}{2}$-inch diameter base is cut $3\frac{1}{2}$-inches from its tip, and the tip is reinserted into the rest of the cone. The e-beam is then directed towards the reentrant cone tip with the sample within the inner cone. While energy depositions significantly greater than those attainable with the conventional design have been achieved (as high as 11 cal/gm at 18 kilojoules) reproducibility remains a problem. This design requires more beam control than chamber pressure alone has been able to provide. (auth)

21937 (ZfK-255) PROGRESS IN THE IN-BEAM MEASUREMENTS OF NANOSECOND ISOMERS. Manfrass, P.; Andrejtscheff, W.; Dubbers, F.; Schilling, K. D.; Seidel, W. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). May 1973. 34p. (In German). Dep. NTIS (US Sales Only) $4.75.

Nanosecond lifetime measurements on the particle beam, demand simultaneously a high quality in the energy and time resolution of γ-detectors. Both conditions can be fulfilled at the present time only by Ge(Li) detectors applying special timing methods. Some methods were investigated (LET, ELET, ARC) which lead to an improvement of the time resolution. Different methods and experimental equipment for investigations of nanosecond isomers on the particle beam of the U-120 cyclotron, the 10-MeV tandem Van de Graaff EPG-10 and the 10-MW research reactor in Rossendorf are described. In the appendix, computer codes for analyzing of time distribution spectra are described. (auth)

21938 DATA ACQUISITION AND CONTROL OF AN EXPERIMENT BY MEANS OF AN ON-LINE COMPUTER. CERN-Trieste High-Energy Group. pp 137-145 of Proceedings of the Triangle Seminar. Haberler, P. L. F. (ed.). Vienna; Institut fuer Hochenergiephysik, Oesterreichische Akademie der Wissenschaften (1972).

From Triangle seminar on experimental high energy physics; Vienna, Austria (9 Oct 1972). See CONF-7210121--.

An experimental apparatus including scintillation counters and wire spark chambers has been automatically monitored by means of an on-line computer. The procedures involved and the devices used are described. Parallel execution of data taking and monitoring operations can give rise to conflicts; the methods of circumventing these problems are discussed in some detail. (auth)

21939 ISAH: A VERSATILE TREATMENT POSITIONER FOR EXTERNAL RADIATION THERAPY. Lyman, J. T.; Chong, C. Y. (Univ. of California, Berkeley). Cancer; 34: No. 1, 12-16(Jul 1974).

From 15th annual meeting of the American Society of Therapeutic Radiologists; New Orleans, LA (24 Oct 1973).

Mechanical features, control philosophy, and operational characteristics are described for the computer-controlled patient positioner, "ISAH" (Irradiation Stereotaxic Apparatus for Humans). The positioner is currently being used with the 910-MeV helium-ion beam from the 184" cyclotron at the Lawrence Berkeley Laboratory. It is capable of positioning a patient to 0.1-mm accuracy in three dimensions. It can simultaneously or selectively translate the patient in three orthogonal axes and rotate him about two perpendicular axes. ISAH is used to deliver a therapeutic dose of radiation to an arbitrarily determined volume within the patient's body during irradiation, so as to minimize exposure to surrounding tissues. The motions are under online control by a PDP-8/I computer which directs the necessary motions and verifies the positioning. The computer also controls the intensity and the depth of penetration of the heavy-ion beam. (auth)

21940 PHYSICAL CHARACTERISTICS OF THE NRL FAST NEUTRON BEAM FOR RADIATION THERAPY. Theus, R. B.; Bondelid, R. O.; Attix, F. H.; August, L. S.; Shapiro, P.; Surratt, R. E.; Rogers, C. C. (Naval Research Lab., Washington, DC). Cancer; 34: No. 1, 17-32(Jul 1974).

From 15th annual meeting of the American Society of Therapeutic Radiologists; New Orleans, LA (24 Oct 1973).

A consortium of therapeutic radiologists in the middle-Atlantic states and physicists at the Naval Research Laboratory has been established to investigate the use of fast neutron beams in the control of some cancerous tumors. Many radiobiology experiments have indicated that neutron beams may have an advantage in the control of local tumors over that of conventional forms of radiotherapy. In preparation for clinical radiotherapy trials, extensive measurements have quantified the various physical characteristics of the NRL cyclotron-produced neutron beam. Techniques have been developed for the absolute determination of delivered dose at depth in tissue for this beam, accounting for the relatively small component of dose delivered by gamma rays, as well as that by the neutrons. A collimator system has been designed to allow the precise field definition necessary for optimum therapy treatment planning. A dose control and monitor unit has been engineered and has demonstrated a reproducibility of 0.2%. New techniques common to nuclear physics experiments have been utilized to obtain needed neutron beam dosimetry information. The relative biological effectiveness of this neutron beam has been studied with several biological systems to aid in determining proper radiotherapeutic dose levels. The objective of these studies is a full-scale clinical radiotherapy trial to test neutron effectiveness as compared to that of conventional radiotherapy. (auth)

21941 STATUS OF LAMPF EXPERIMENTAL FACILITIES. Thiessen, H. A. (Los Alamos Scientific Lab., NM). pp 416-418 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973). See CONF-730642-.

The experimental facilities which are being prepared for the Clinton P. Anderson Meson Physics Facility (LAMPF) are briefly reviewed. A status report for each beam line and experimental area is presented, and the latest estimate for the date of initial operation of each is discussed. Operating experience with the accelerator is reviewed. (auth)

21942 STATUS OF THE EXPERIMENTAL FACILITIES AT SIN. Petitjean, C. (Swiss Inst. for Nuclear Research, Villigen). pp 419-422 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973). See CONF-730642-.

A status report is given of the experimental facilities and the physics program at SIN. The 590 MeV proton accelerator is scheduled to accelerate a first beam later this year. First meson beams will be available in spring 1974. (auth)

21943 EXPERIMENTAL PROGRAMME AT TRIUMF. Measday, D. F. (Univ. of British Columbia, Vancouver). pp 423-426 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973). See CONF-730642-.

A brief statement of the main characteristics of TRIUMF is followed by a status report of the major components. The experimental facilities are surveyed and an outline is given of the initial scientific programme. (auth)

21944 DYNAMIC POLARIZATION OF PROTONS, DEUTERONS, AND CARBON-13 NUCLEI; THERMAL CONTACT BETWEEN NUCLEAR SPINS AND AN ELECTRON SPIN-SPIN INTERACTION RESERVOIR. de Boer, W.; Borghini, M.; Morimoto, K.; Niinikoski, T. O.; Udo, F. (CERN, Geneva). J. Low Temp. Phys.; 15: No. 3-4, 249-267(May 1974).

Hydrogen, deuterium, and carbon-13 nuclear spin systems were studied in partially deuterated 1,2-ethanediol $(CD_2OH)_2$, doped with paramagnetic Cr^V complexes, between 0.1 and 0.5°K, using the technique of dynamic polarization. Various steady-state and transient measurements demonstrate the existence of a thermal contact between the different spin species of this sample and the electron spin-spin interaction reservoir. The lowest spin temperature attained was about 1.2 mK in a magnetic field of 25 kG, which corresponds to a proton polarization of 97%, to a deuteron polarization of 40%, and to a carbon-13 polarization of 48%. (auth)

PHYSICS (ASTROPHYSICS AND COSMOLOGY)

Cosmic Radiation

Refer also to abstracts 21253, 22121, and 22355.

21945 (CONF-730804-P5) 13TH INTERNATIONAL COSMIC RAY CONFERENCE, DENVER, COLORADO, 17–30 AUGUST 1973. Volume 5. Miscellany, Invited Lectures and Memorial Sessions, Rapporteur Papers. (Denver Univ., Colo. (USA)). 1973. 719p. Dep. NTIS $39.00.

Separate abstracts are prepared for the 56 papers presented. (CES)

For abstracts of individual papers see: 21946–21991, 22054–22057, 22068–22071, 22104, and 22355.

21946 (CONF-730804-P5, pp 3055-3060) CHARGE AND ISOTOPE MEASUREMENTS OF HEAVY COSMIC-RAY NUCLEI AND THEIR ROLE IN THE DETERMINATION OF THE COSMIC-RAY AGE. Damle, S. V. (Tata Inst. of Fundamental Research, Bombay); Webber, W. R.; Kish, J. 1973.

From thirteenth international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 5.

Detailed measurements of the charge and isotope composition of cosmic ray nuclei with Z = 10-28, made on several balloon flights in the summers of 1970, 71 and 72 at Ft. Churchill in Canada. These measurements were made with our large area double dE/dX × Cerenkov × total energy telescope and provide energy spectra in the energy range 200 MeV/nuc. to 1200 MeV/nuc. The measured charge or isotope composition is strongly dependent on the presence or absence of certain radio-active nuclei that decay by electron capture or by beta decay. Some of these lifetimes are of the order of the expected lifetime of cosmic rays and therefore may be used to extract information on the lifetime and propagation conditions of cosmic rays. Four particularly interesting nuclei are Al, K, Cr and Mn. The energy dependent abundances of these nuclei are presented and the source composition of cosmic rays is discussed. (auth)

21947 (CONF-730804-P5, pp 3061-3066) 1972-COSMIC-RAY ELECTRON SPECTRUM ABOVE 0.5 GeV. Burger, J. J.; Swanenburg, B. N. (Kamerlingh Onnes Lab., Leiden). 1973.

From thirteenth international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 5.

The cosmic-ray electron spectrum above 0.5 GeV has been measured during a special operation of the OGO-5 satellite from June 30–July 13, 1972. The results are presented and compared with earlier data provided by the same instrument over the period March 1968–August 1971. (auth)

21948 (CONF-730804-P5, pp 3067-3072) HODOSCOPE MEASUREMENTS OF THE SPECTRUM OF COSMIC ELECTRONS BETWEEN 10 GeV AND 100 GeV. Meegan, C. A.; Earl, J. A. (Univ. of Maryland, College Park). 1973.

From thirteenth international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 5.

The spectrum of cosmic electrons was measured using a Geiger tube hodoscope which contains 33 radiation lengths of lead absorber and has a geometric factor of 335 cm^2 sterad. The instrument was calibrated at the Cornell Electron Synchrotron and flown twice for a total of 30 hours at a ceiling altitude of 5 millibars. The differential spectrum from 10 GeV to 100 GeV is given by $dJ/dE = 990\ E^{-3.5\pm.1}$. (auth)

21949 (CONF-730804-P5, pp 3073-3078) OBSERVATION OF HIGH-ENERGY PRIMARY ELECTRONS WITH EMULSION CHAMBER. Ishii, C. (Aoyamagakuin Univ., Tokyo); Kobayashi, T.; Shigihara, N.; Yokoi, K.; Matsuo, M.; Nishimura, J.; Taira, T.; Niu, K. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol 5.

In order to observe the spectrum of high energy electrons in the cosmic rays, a large emulsion chamber is specially designed and exposed to a high altitude by a balloon in 1973. The total area of this chamber is 2,000 cm^2, and was exposed for about 14 hours at an atmospheric depth of about 8 g/cm^2. A scanning is made over the whole area for showers with energy higher than 400 GeV, corresponding to $S\Omega T$ of about 20,000 $m^2 \cdot sec \cdot str$. Another scanning is made for showers with energy higher than 100 GeV over the area of 210 cm^2, corresponding to $S\Omega T$ of about 2,000 $m^2 \cdot sec \cdot str$. The observed upper limit of the primary electron energy spectrum has been pushed up to about 1 TeV by the present experiment and, combining the data with those hitherto reported by our group, it is found that the spectrum of the primary electrons with energy higher than 100 GeV is well represented by $J(E) = 1.1 \cdot 10^{-4} \cdot (100\ GeV/E)^{3.2\pm0.3}/m^2 \cdot sec \cdot str \cdot GeV$. The result is consistent with our previous one showing a depression of the electron intensity in high energy region. (auth)

21950 (CONF-730804-P5, pp 3079-3085) COSMIC NUCLEAR GAMMA RAYS. Meneguzzi, M.; Reeves, H. (CEN, Saclay, France). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 5.

Nuclear gamma ray emission by cosmic rays interacting with thermal particles is calculated in various situations, using the available nuclear cross-section data. The predicted diffuse flux from the interstellar medium is calculated in the case of the existence of an intense low energy cosmic ray flux, responsible for the heating of the H I regions as well as the ^7Li production in the galaxy, and compared with observations. The expected fluxes from cosmic ray sources for several source candidates (supernovae, radiogalaxies or seyfert galaxies) are presented and it is shown that detection of these objects in the nuclear gamma ray energy range is not impossible. (auth)

21951 (CONF-730804-P5, pp 3086-3091) PROTON–ALPHA INELASTIC CHANNELS AN APPLICATION TO THE FORMATION OF d AND ^3He IN COSMIC RAYS. Jung, M. (Universite de Strasbourg); Suren, J. N.; Sakamoto, Y.; Jacquot, C.; Kaiser, R.; Schmitt, R. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 5.

Starting with some simple theoretical assumptions relations have been established for the differential and absolute cross sections of d and He-3 production in $p + \alpha$ and $\alpha + p$ interactions at medium incident energies. The contribution to the formation of d and He-3 of those reactions are calculated compared to the other production possibilities namely: $p + p$, $\alpha + \alpha$, $p +$ CNO and CNO + p reactions. The calculations are done for three kinds of primary spectra: kinetic energy/nucleon, total energy/nucleon and rigidity in order to compare the relative importance of the production channels. The particle transport is supposed to be affected by energy-loss and inelastic collisions while the diffusion term is replaced by a leakage mean-free path in a steady state model. (auth)

21952 (CONF-730804-P5, pp 3092-3097) POSSIBILITY OF A CONTRIBUTION TO THE PRIMARY COSMIC-RAY SPECTRUM FROM PULSARS. Karakula, S. (Univ. of Durham, Eng.); Osborne, J. L.; Wdowczyk, J. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 5.

The model of Gunn and Ostriker predicts the form of the spectrum of cosmic rays emitted by a given pulsar. The observed frequency distribution of pulsar periods, P, and their rate of increase dP/dt, is used to obtain the form of the energy spectrum emitted by all the pulsars together. In the region below 10^{14} eV the spectrum from pulsars is too flat for them to be making a significant contribution to the observed primary spectrum and another source of cosmic rays must be sought. From 10^{14} eV to 10^{18} eV (i.e. in the region covering the break in the primary spectrum), however, the majority of cosmic rays could come from pulsars. A reasonable birth rate of pulsars in the Galaxy could account for the observed total energy content of cosmic rays in this part of the spectrum. Absorption in the supernova shell would cut off the spectrum above 10^{16} eV. (auth)

21953 (CONF-730804-P5, pp 3098-3105) MULTIPLE SCATTERING OF CHARGED PARTICLES IN MAGNETIC FIELD. Thielheim, K. O. (Univ. of Kiel). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 5.

Charged particle propagation in irregular magnetic fields is investigated. Multiple small angle scattering is considered in a model field configuration. The irregular magnetic field components are specified by their energy density and autocorrelation function. The mean deviation from ideal particle direction is given explicitly. A diffusion equation with variable diffusion coefficient is estab-

lished, ordinary diffusion theory is found to be valid asymptotically. Results are applied for an estimation on the range of validity of the single particle approach to the propagation of primary cosmic ray particles at extremely high energies. (auth)

21954 (CONF-730804-P5, pp 3106-3116) LONG-TERM MODULATION OF COSMIC RAYS. Bedijn, P. J.; Burger, J. J.; Swanenburg, B. N. (Kamerlingh Onnes Lab., Leiden). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 5.

The long-term intensity variations of cosmic-ray electrons, protons and α-particles over the period 1965–1971 have revealed a pronounced energy-dependent hysteresis effect. Numeric integrations of the interplanetary cosmic-ray transport equation are presented, which show that these observations can be reproduced quite reasonably with a non-separable model for the diffusion coefficient, in which changes are introduced only in the rigidity dependence of the local diffusion coefficient k_e above a transition rigidity, varying around 3 GV, below which k_e is permanently independent of rigidity. The solutions presented match with: a. The observed energy spectra of cosmic-ray electrons, protons, and α-particles above roughly 50 MeV (/nucleon), b. The observed intensity variations, including the hysteresis effects, c. The observed cosmic-ray gradients as a function of energy, d. The puzzling small changes observed for the magnetic power spectra and solar wind velocity. The solutions indicate an energy dependent effective size of the modulation cavity, which may be significantly larger than 10 a.u. for medium and low energy particles. (auth)

21955 (CONF-730804-P5, pp 3117-3122) SHORT-TERM INTENSITY FLUCTUATION OF COSMIC-RAY ELECTRONS BETWEEN 0.5 AND 10 GeV. Burger, J. J.; Swanenburg, B. N. (Kamerlingh Onnes Lab., Leiden). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 5.

The cosmic-ray electron spectrum between 0.5 and 10 GeV has been monitored continuously from March 1968 until August 1971 aboard the OGO-5 satellite. These observations permit a detailed assessment of the long-term intensity variations (11-year cycle) as well as the short-term fluctuations (e.g. Forbush decreases). The results show a distinct difference in the rigidity dependence between these two effects. The implications for the description of the transport of cosmic rays in the solar cavity are discussed. (auth)

21956 (CONF-730804-P5, pp 3123-3128) ABSORPTION OF PRIMARY COSMIC RAYS IN THE ATMOSPHERE. Suren, J. N. (Universite de Strasbourg); Jung, M.; Kaiser, R.; Schmitt, R. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 5.

A computer program has been elaborated in order to interpret angular distributions and fluxes measurements of cosmic-ray particles registered in balloon experiments flown at different altitudes and rigidity cut off. The calculations are done in the frame of standard atmosphere and slab model taking into account inelastic destruction and production as well as energy-loss. The variation of flux and angular distribution is given for different altitudes and rigidity cut off. In order to check the model a comparison is made between calculated and experimental results from emulsion experiments for which we could classify VH, H, M groups and measure angular distributions and respective ratios. (auth)

21957 (CONF-730804-P5, pp 3129-3133) HIGHER HARMONICS IN COSMIC-RAY SOLAR DAILY VARIATION. Ahluwalia, H. S.; Singh, S. (Univ. of New Mexico, Albuquerque). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 5.

The analysis of the neutron monitor data, for a period of six years (1966-71), from Deep River and Dallas, is presented. These data are examined to ascertain whether harmonics higher than third also exist in the solar daily variation of cosmic rays. It is found that the fourth and higher harmonics are observed in the cosmic ray data at Dallas. However, it is shown that these harmonics are most probably of barometric origin. It appears that the data are under-corrected for the variations of atmospheric pressure at Dallas. A correction coefficient of -0.15% mb^{-1} to remedy this situation is derived. It is concluded that at present there is no evidence of harmonics higher than third in the solar daily variation of cosmic rays. (auth)

21958 (CONF-730804-P5, pp 3134-3138) SEARCH FOR CUT-OFF VARIATIONS AT MID-LATITUDE STATIONS. Debrunner, H. (Univ., Bern); Flueckiger, E.; Arens, M.; Skolnik, J.; Binder, O. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 5.

It is shown that the neutron monitor data of Jungfraujoch, Kiel and Utrecht allow a determination of cutoff changes at Jungfraujoch. Excluding cutoff variations during solar flare events an accuracy of ±0.15 GV is expected. (auth)

21959 (CONF-730804-P5, pp 3139-3144) PHASE LAG EFFECT IN THE COSMIC-RAY MODULATION DURING SOLAR CYCLE TWENTY. Lockwood, J. A.; Lezniak, J. A.; Webber, W. R. (Univ. of New Hampshire, Durham). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 5.

In this analysis of the phase-lag effect, more extensive primary proton and helium spectral data from balloon studies of the University of New Hampshire group, from the Pioneer 8 and 9 spacecraft, and from ground-level monitors during 1965–72 are used. If the rigidity dependence of the diffusion coefficient at earth did not change from 1968–72, then the data imply the nonseparability of the radial and rigidity parts of the diffusion coefficient. (auth)

21960 (CONF-730804-P5, pp 3145-3150) ANISOTROPIES OF GALACTIC COSMIC RAYS OUTSIDE THE ORBIT OF EARTH MEASURED ON PIONEER 10. Lentz, G. A.; McCarthy, J.; O'Gallagher, J. J. (Univ. of Maryland, College Park). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 5.

Preliminary results of observations of the directional distribution of cosmic rays being conducted by the University of Chicago experiment on the Pioneer 10 spacecraft are presented. The unusual geometry of the directional scan is described and some features of the response of a bi-directional coincidence telescope are discussed. Selected periods free from the presence of low energy solar particles exhibit transient deviations from uniform directional distributions for the bi-directional flux of nuclei >67 MeV/nucleon. These deviations are typically 2 to 4 (±1) percent and are oriented very roughly in a N-S direction. Such non-uniformities observed with a bi-directional detector can only be due to even order terms in the angular distribution function. (auth)

21961 (CONF-730804-P5, pp 3156-3161) RANGE FLUCTUATIONS OF HIGH-ENERGY MUONS. Kobayakawa, K. (Kobe Univ., Japan). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 5.

The average range-energy relation of high energy muons and the range fluctuations are revised. The recent calculations are adopted for the pair production, bremsstrahlung and nuclear interaction. The conversion of the two empirical depth-intensity curves into the energy spectrum of muons at sea-level is done. The results through various differential cross-sections are compared with each other. (auth)

21962 (CONF-730804-P5, pp 3162-3166) ABSOLUTE MEASUREMENT OF COSMIC-RAY MUON INTENSITY NEAR 1 GeV/c. Lau, S. Y.; Ng, L. K.; Young, E. C. M. (Univ. of Hong Kong, Japan). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 5.

The absolute vertical muon intensities near sea level have been determined in Hong Kong where the geomagnetic cut-off rigidity is 16.3 GV. The integral intensities obtained are $(6.73 \pm 0.03) \times 10^{-3}$, $(6.46 \pm 0.03) \times 10^{-3}$ and $(6.20 \pm 0.04) \times 10^{-3}$ cm^{-2} sr^{-1} s^{-1} at momenta (1,100 ± 36),(1,202 ± 40) and (1,297 ± 43) MeV/c respectively and the differential intensity at 1,250 MeV/c $(2.67 \pm 0.38) \times 10^{-4}$ cm^{-2} sr^{-1} s^{-1} (MeV/c)$^{-1}$. The results are compared with recent absolute measurements at various geomagnetic latitudes. It is found that the results are consistent when account is taken of the latitude effect, the altitude effect and 11-year cycle variation. The effect of the variation of absolute intensities on the various factors is discussed. (auth)

21963 (CONF-730804-P5, pp 3167-3171) INVESTIGATIONS OF THE HORIZONTAL AIR SHOWERS. Gawin, J. (Inst. of Nuclear Research, Lodz, Poland); Hibner, J.; Wdowczyk, J.; Catz, Ph.; Hochart, J. P.; Milleret, G.; Maze, R.; Zawadzki, A. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 5.

The muonic content of horizontal air showers is discussed for both hypotheses of high energy muons initiating these showers either by bremsstrahlung or by some kind of nuclear interaction occurring deep in the atmosphere. Calculations suggest that bremsstrahlung showers may be not as muon-poor as one could expect. A description is given of an experimental set-up for investigation of the horizontal air showers. (auth)

21964 (CONF-730804-P5, pp 3172-3178) COSMIC-RAY MUONS UNDERWATER. Anderson, S. (Univ. of Washington, Seattle); Lord, J. J.; Kotzer, P.; Stehling, K. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 5.

Background-free nuclear emulsions have been prepared by aquanaut scientists in an under-water laboratory 15 meters deep. Three hundred grams of emulsions were placed at the 11 meter depth and 470 grams were placed by SCUBA to a 33 meter depth. Additional emulsions were placed by an alternate method to 100 meters. The emulsions were used to measure stopping muon and star production rates underwater and to compare these rates to measurements made underground. (auth)

21965 (CONF-730804-P5, pp 3179-3183) INTERACTIONS OF 2.1 GeV/N ACCELERATED CARBON, NITROGEN, AND OXYGEN IONS. Kaiser, R. (Universite de Strasbourg); Pfohl, R.; Jung, M. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 5.

Several stacks of different kinds of nuclear emulsion have been exposed to 2.1 GeV/n carbon, nitrogen and oxygen beams at the Bevatron [Lawrence Berkeley Laboratory, Berkeley, Cal. USA]. From the study of the stars, results such as mean free-paths, angular and branch distributions of jets, fragments and evaporation products are given. These results are compared to those obtained by the study of the interactions of cosmic heavy ions in the same range of energy. (auth)

21966 (CONF-730804-P5, pp 3184-3189) COSMIC-RAY NUCLEAR INTERACTIONS OVER 5 TeV AND COMPARISON WITH SCALING. Martin, J. W.; Florian, J. R.; Gibbs, R. E.; Kotzer, P.; Lord, J. J. (Univ. of Washington, Seattle). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 5.

Emulsion chambers have been exposed to cosmic rays at balloon altitudes. Multiparticle angular distributions were measured for collisions in emulsion and hydrocarbon targets. Effects due to intranuclear cascading have been studied in detail with special emulsions containing small pellets of pure tungsten. (auth)

21967 (CONF-730804-P5, pp 3190-3195) OBSERVATION OF HIGH-ENERGY γ-RAYS AND HADRONS WITH Fe-EMULSION CHAMBER. Yuda, T. (Kanagawa Univ., Yokohama, Japan); Taira, T.; Shibata, M.; Taira, K. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 5.

560 showers with energy greater than 1.5 TeV were observed with thick Fe-emulsion chamber exposed at Mt. Fuji (3776 m above sea level). Using this preliminary data, attenuation mean free path of hadron in Fe, energy spectrum of electromagnetic and hadronic component were obtained. From this, the reliability of Fe-emulsion chamber for the detection of both γ-rays and hadrons was confirmed. (auth)

21968 (CONF-730804-(P 5, pp 3196-3201) NONAXIALLY SYMMETRIC DISTRIBUTION OF RADIO WAVE INTENSITY EMITTED FROM AN EXTENSIVE AIR SHOWER. Fujii, M.; Nishimura, J. (Tokyo Univ.). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 5.

The existence of the nonaxially symmetric transverse current in a shower disc is predicted in addition to the axially symmetric transverse current given by Kahn– Lerche. Since the density of the new current is comparable to the normal transverse current density, the numerical evaluation is carried out for the lateral distribution of the radio wave emitted by this new current using the three dimensional cascade theory. The contribution of the free wave and standing wave is carefully examined, and it is found that the nonaxially symmetric component of radio wave is contributing about 30% to the total intensity beyond the distance of 100 m from the shower axis. The contribution from the dipole moment is evaluated relating to the nonaxially symmetric distribution of the radio wave. It is found the contribution is negligible for the radio wave at a frequency of several ten MHz as already shown in the Kahn– Lerche theory, but the wave through the process plays an important role at several MHz region. (auth)

21969 (CONF-730804-P5, pp 3202-3206) VOLCANO RANCH EVIDENCE ON COSMIC-RAY COMPOSITION. Linsley, J. (Univ. of New Mexico, Albuquerque). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 5.

Statements germane to an eventual recalculation of the 1963 energy spectrum are discussed, and the approach is outlined. (MHR)

21970 (CONF-730804-P5, pp 3207-3211) VOLCANO RANCH EVIDENCE ON THE COSMIC-RAY ENERGY SPECTRUM: A PRELIMINARY RE-EVALUATION. Linsley, J. (Univ. of New Mexico, Albuquerque). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 5.

A re-interpretation is offered of our previous result which showed A) remarkably small variance in muon content (the ratio of muons to total particles) for a sizable group of nearly vertical showers, and B) large fluctuations in muon content and lateral structure for a much smaller group of very inclined showers. If present conflicts as to the elevation at which large showers reach maximum development are resolved in favor of the early evidence from Chacaltaya, then the relatively strong result A will constitute evidence that above 1017 eV the mean free path of shower primaries is substantially less than 70 g cm^{-2}, the geometric value for protons in air. This conclusion would hold in addition to the one originally published, that result A implies a relatively pure primary composition. It would conflict, however, with result B. A more careful study of the data indicates that the apparent large variance of the very inclined showers can be attributed to expected errors in the determination of zenith angle. Also presented are previously unpublished determinations of muon content as a function of shower size, and of muon lateral structure. The structure data yield a value for the ratio of muon size to conventional size as measured at Volcano Ranch. (auth)

21971 (CONF-730804-P5, 3212-3219) STRUCTURE FUNCTION OF EAS MEASURED AT VOLCANO RANCH. Linsley, J. (Univ. of New Mexico, Albuquerque). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 5.

Preliminary results are given of a new measurement, using 9 cm thick unshielded scintillation detectors, of "particle density" as a function of core distance for EAS with energy up to 1019 eV. This measurement will give the radial dependence to within 0.5 Moliêre or less, whereas our previous results for showers of that energy were limited to distances greater than 2 Moliêre. The new determination will lead to improved values of shower size for the largest EAS observed here, values with appreciably reduced uncertainty. New data on 2 events with $N \sim 5 \cdot 10^9$ confirm previous indications that the "effective age" of large EAS varies in individual showers, being less at small than at large core distances. In both events the value of s varies from 1.20 ± 0.05 for $5 < R/R_0 < 10$ to 1.00 ± 0.05 for $1 < R/R_0 < 2$. In one event it is possible to follow the variation to core distance 0.25 Moliêre. The age parameter continues to decrease, approaching a value 0.8 or less. Also reported are some previously unpublished structure measurements which were part of the experimental basis for the empirical formula VRV that was used in deriving our 1963 size and energy spectra. (auth)

21972 (CONF-730804-P5, pp 3220-3225) CHANGE OF THE INTERACTION CHARACTER AROUND 10^{17} eV. Miyake, S.; Ito, N.; Kawakami, S.; Hayashida, N.; Hayashi, Y. (Osaka Univ.). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 5.

The average age parameters and the distribution of local high energy events of EAS have been measured relevant to the size of EAS at mountain altitude. From the results, it was found that the average age parameter becomes slowly younger with size up to around 3×10^7 and turns to become older at larger sizes. At around the same size of above change, the lateral distribution of local energetic events also has a change to become broader. The cause of these changes seems to be a change of interaction character around 10^{17} eV. (auth)

21973 (CONF-730804-P5, pp 3226-3231) COMPARISON OF THE ELECTRON AND HIGH-ENERGY HADRON FLUX IN INDI-

VIDUAL EAS CORES. Samorski, M.; Aschenbach, B.; Boehm, E. (Univ., Kiel). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 5.

The core structure of the electron and hadron component has been measured simultaneously in individual EAS of size $N > 2.5 \cdot 10^5$ particles at sea level by means of two neon hodoscopes of area 31 and 14 m^2, respectively. No substructure in the electron distribution of the cores has been observed even for EAS with high density of hadrons with energies larger than 1 TeV. Parameters characterizing the slope of the electron density distribution in the core have been determined for showers with different density and different energy flux of hadrons. The results of this analysis are presented. (auth)

21974 (CONF-730804-P5, pp 3232-3236) FURTHER DEVELOPMENT OF THE YAKUTSK EAS ARRAY AND THE METHODICAL PROBLEMS. Diminstein, A. S.; Glushkov, A. V.; Kaganov, L. I.; Maximov, S. V.; Mikailov, A. A.; Pravdin, M. I.; Sokurov, V. F.; Yefimov, N. N. (Inst. of Cosmophysical Research and Aeronomy, Yakutsk, USSR). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 5.

The experimental arrangement of the Yakutsk EAS complex array is described. The experimental results on the charged particles lateral distribution in showers of primary energy 10^{17} to 10^{19} eV are presented. A program of the further EAS investigations by means of Cerenkov and ionization radiation detectors and muon detectors is put forward. (auth)

21975 (CONF-730804-P5, pp 3239-3244) CHARGE AND ENERGY SPECTRUM OF ULTRA HEAVY COSMIC-RAY PRIMARIES. Fowler, P. H. (Univ. of Bristol, Eng.); Thorne, R. T.; Muzumdar, A. P.; O'Ceallaigh, C.; O'Sullivan, D.; Rao, Y. V.; Thompson, A. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 5.

An account is given of the analysis of large area Lexan Emulsion Sandwich stacks flown from Sioux Falls in 1971 and 1972. The total exposure was 39 m^2 days at ~3.5 g cm^{-2} atmospheric depth and 120 tracks of nuclei with $Z \geq 30$ were found. The energy spectrum for nuclei with $Z \geq 70$ has been measured and shown to be similar in form to that of nuclei of low Z. (auth)

21976 (CONF-730804-P5, pp 3245-3249) POSSIBLE OBSERVATION OF HIGH-ENERGY X-RAYS FROM THE PERSEUS CLUSTER. Bui-Van, A.; Hurley, K.; Vedrenne, G. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 5.

X-radiation has been observed from the Perseus cluster at energies between 53 and 93 keV, with 3 σ confidence. If this observation is confirmed by later measurements, the spectrum would be consistent with a power law. (auth)

21977 (CONF-730804-P5, pp 3250-3252) NEW SOURCE OF HIGH-ENERGY COSMIC RAYS. Narlikar, J. V. (Tata Inst. of Fundamental Research, Bombay). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 5.

It is suggested that high energy cosmic rays originate in explosive events involving primary creation of matter. Such events are small scale versions of the "big-bang" event which is supposed to start off a Friedmann universe. A simple theory of matter creation in mini-bangs is given. One by-product of this theory is the removal of singularity usually considered inevitable in Einstein's general theory of relativity. The relevance of this to cosmic rays in particular and high energy astrophysics in general is discussed. (auth)

21978 (CONF-730804-P5, pp 3253-3258) MONOENERGETIC-SOURCE SOLUTIONS OF THE STEADY-STATE COSMIC-RAY EQUATION OF TRANSPORT. Webb, G. M. (Univ. of Tasmania, Australia); Gleeson, L. J. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 5.

Analytic, steady state, solutions of the cosmic-ray equation of transport for the solar cavity are given for monoenergetic particles released continuously at a specified heliocentric radius. The solutions are used to illustrate energy change processes. A new feature is an apparent buildup of particles at very low energies. (auth)

21979 (CONF-730804-P5, pp 3261-3266) EFFICIENT IDENTIFICATION OF RELATIVISTIC PARTICLES BY TRANSITION RADIATION. Cherry, M. L.; Mueller, D.; Prince, T. A. (Univ. of Chicago). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 5.

A system of transition radiation detectors has been constructed and exposed to beams of electrons and pions in the energy range 3 GeV to 15 GeV at SLAC. Transition radiation was generated in a variety of stacks of mylar foils (radiators), and its intensity was detected with 7 multiwire proportional chambers. The raw data demonstrate a good separation between electron and pion induced signals. A more detailed analysis shows that a very efficient identification of individual particles is possible. Typically, a detection efficiency for electrons above 90%, combined with a pion–electron discrimination ratio of 10^{-3}, has been achieved. Some conclusions with respect to the design of a practical detector for relativistic particles are drawn. (auth)

21980 (CONF-730804-P5, pp 3285-3303) COLLAPSED OBJECTS. Pacini, F. (Laboratorio di Astrofisica Spaziale, Frascati, Italy). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 5.

The role of collapsed objects as energy sources in high energy astrophysics is presented. The basic physics involved and the various models proposed for some of the observed phenomena are reviewed. (MHR)

21981 (CONF-730804-P5, pp 3304-3322) RECENT DEVELOPMENTS IN EXPLOSIVE NUCLEOSYNTHESIS. Truran, J. W. (Univ. of Illinois, Urbana). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 5.

A discussion is presented of recent theoretical studies relevant to nucleosynthesis in supernovae. Particular attention is devoted to two general problems: (1) the consequences of explosive charged-particle nucleosynthesis occurring in the core matter ejected by supernovae and (2) the implications of a detailed theoretical analysis of the physics of the shock front structure (Colgate 1973 a,b) for nucleosynthesis in supernova envelopes. Existing theories are briefly reviewed and the mechanisms believed to be responsible for the synthesis of nuclei in various mass ranges are identified. (auth)

21982 (CONF-730804-P5, pp 3323-3353) NUCLEOSYNTHESIS AND THE ORIGIN OF THE GALACTIC COSMIC RAYS. Reeves, H. (Sep/Saclay, France). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 5.

Three topics are considered separately in which galactic cosmic rays and nucleosynthesis are, in some way, related together and also to their likely source: the explosion of a supernova and the expansion of the corresponding supernova remnant. The three topics are: atoms, stars, and cosmic rays; shockwave nucleosynthesis, or, how much energy comes out of a supernova; and the galactic cosmic rays as an agent of nucleosynthesis. (MHR)

21983 (CONF-730804-P5, pp 3399-3418) COSMIC-RAY ARCHAEOLOGY. Lal, D. (Physical Research Lab., Ahmedabad, India). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 5.

The problem of fluxes and spectral shapes of charged particles in space at 1 to 3 A.U. (at lunar and meteoritic orbits) during geological periods is presented. The information available to date is discussed, separately for protons and alpha particles based on radionuclide data and for the multicharged $Z \geq 20$ nuclei, based on fossil track data. (MHR)

21984 (CONF-730804-P5, pp 3513-3567) COSMIC-RAY CHARGE COMPOSITION ($Z \leq 28$). Garcia-Muonz, M. (Univ. of Chicago). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 5.

Electrons, positive and negative, are excluded, as well as all the elements with nuclear greater than 28. Neighboring topics as cosmic ray sources, propagation, spectral forms, modulation, etc. are considered to the extent that they are directly related to the subject. First, the experimental information on cosmic ray

composition contributed at this conference is summarized. The measured abundances classified in order of increasing energy are discussed. At intermediate and high energies the most important subject is the change of the composition with energy and the experimental results are discussed from this point of view. The experimental survey is concluded with a brief review of the subject of antimatter in the cosmic radiation. Next, deductions are made from the information gathered. The main objective is to obtain the cosmic ray source abundances in order to identify the sources. Two main problems appear here: One is the extrapolation of the experimental abundances back to the source and the other is to ascertain the role played by the injection and acceleration mechanisms in modifying the original source composition. (MHR)

21985 (CONF-730804-P5, pp 3568-3614) ENERGY SPECTRA OF THE COSMIC-RAY NUCLEONIC AND ELECTRONIC COMPONENTS. Webber, W. R. (Univ. of New Hampshire, Durham). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 5.

New and significant developments with regard to the energy spectra of nuclei are reviewed, as well as some important differences in experimental results. The following areas are covered: medium and high energy nuclei spectra, low energy nuclei spectra, low energy electron and positron spectra, and medium and high energy electrons and positrons. (MHR)

21986 (CONF-730804-P5, pp 3615-3626) COSMIC-RAY ISOTOPES. Stone, E. C. (California Inst. of Tech., Pasadena). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 5.

Results presented at this conference are reviewed under the following topics: H and He isotopes, Be isotopes, Al isotopes, Fe isotopes, cross and model calculations, and instrumental considerations. (MHR)

21987 (CONF-730804-P5, pp 3627-3637) ULTRA HEAVY COSMIC RAYS. Fowler, P. H. (Univ. of Bristol, TX). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 5.

The new data presented here is summarized and compared with published data and the significance of this component of the primary cosmic radiation is discussed briefly. The following topics are covered: the energy spectrum, the charge spectrum and the primary and source cosmic ray spectra, $Z \geq 35$. (MHR)

21988 (CONF-730804-P5, pp 3638-3655) RAPPORTEUR PAPER ON MUONS AND NEUTRINOS. Miyake, S. (Tokyo Univ.). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 5.

The main topics covered in the muon and neutrino sessions are: the X-process, stopping muons, horizontal air showers, and the W-boson. (MHR)

21989 (CONF-730804-P5, pp 3656-3667) RAPPORTEUR PAPER ON EXTENSIVE AIR SHOWERS. Porter, N. A. (Univ. College Dublin). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 5.

Papers presented in the air shower sections at the conference are considered under the headings: primary energy spectrum, anisotropies, optical Cherenkov and radio emission, primary composition and fluctuations, nuclear interactions and meson multiplicities, structure, and some anomalous events. There is an increased emphasis on detailed model calculations, the desirability of simultaneous observations of different parameters in individual showers, and the importance of fluctuations. In techniques, there is a noticeable revival of interest in optical Cherenkov emission. (MHR)

21990 (CONF-730804-P5, pp 3668-3684) RESULTS CONCERNING STRONG INTERACTIONS. Ramana Murthy, P. V. (Univ. of Michigan, Ann Arbor). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 5.

The topics covered are: accelerator results, quark research, inelastic interactions, and techniques. (MHR)

21991 (CONF-730804-P5, pp 3706-3730) MODULATION OF THE GALACTIC COSMIC RAYS. Castagnoli, G. C. (Universita di Turin). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 5.

Results presented in this conference on the classical topics related to the modulation of the galactic cosmic rays in the energy range 1 to 1000 GeV are summarized. These are rapid time variations, solar diurnal variations, sidereal variations, and Forbush decreases. Papers dealing with technical problems related to the correction and the treatment of the data are reviewed. (MHR)

21992 (N-73-33777) SATELLITE MEASUREMENT OF COSMIC-RAY ABUNDANCES AND SPECTRA IN THE CHARGE RANGE $2 \leq Z \leq 10$. Brown, J. W. (California Inst. of Tech., Pasadena (USA)). Jun 1973. Contract NAS5-9312. 118p. (NASA-CR-135786; SRL-73-2). NTIS $8.00.

Thesis.

The compositon of the nuclear component of the cosmic radiation was studied to yield information concerning the source, propagation, and confinement of cosmic rays within the Galaxy. The first comprehensive satellite measurement is presented of cosmic-ray composition and spectra in the charge range $2 \leq Z \leq 10$ using the geomagnetic field as a rigidity analyzer through the entire range of vertical cutoffs. The results indicate that the spectra of all the elements in the observed range are similar, and thus that various ratios of elemental abundances are nearly independent of rigidity over the range $2 \leq P \leq 15$ GV. Calculations of the propagation of cosmic rays through the interstellar and interplanetary media predict that there should be a variation with rigidity of ratios of various elements, because of the charge-dependent effects of ionization of the interstellar gas by the cosmic rays. The absence of this variation can be explained by assuming a rigidity-dependent confinement of the cosmic rays in the Galaxy. (auth) (STAR)

21993 (N-73-33778) SAS-2 OBSERVATIONS OF GAMMA RAYS FROM THE GALACTIC PLANE. Kniffen, D. A.; Hartman, R. C.; Thompson, D. J.; Fichtel, C. E. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). Sep 1973. 12p. (NASA-TM-X-70486). NTIS $3.00.

The SAS-2 gamma-ray experiment has made measurements on the high-energy gamma rays coming from the galactic center region. The gamma radiation in this region is very much more intense than in the anticenter region, in agreement with the observations made with the OSO-3 experiment of Kraushaar et al. (1973); and exhibits a narrow distribution along the plane which is nearly uniform in intensity from 330° to 30°. The energy spectrum in the range from 35 to 210 MeV is quite flat, consistent with a cosmic ray-interstellar matter interaction pion-decay spectrum, or a mixture of this spectrum and a spectrum formed by Compton radiation from cosmic-ray electrons. The intensity of the radiation in the anticenter direction is consistent with that expected from the cosmic ray-interstellar matter interaction origin. (auth) (STAR)

21994 (N-74-16510) STUDY OF COSMIC-RAY POSITRON AND ELECTRON SPECTRA IN INTERPLANETARY AND INTERSTELLAR SPACE AND THE SOLAR MODULATION OF COSMIC RAYS. Cummings, A. C. (California Inst. of Tech., Pasadena (USA)). Mar 1973. 284p. (NASA-CR-136772; SRL-73-1). NTIS $16.25.

Thesis.

The differential energy spectra of cosmic-ray positrons and negatrons with energies between approximately 11 and 1500 MeV was measured during the period 1968-1971 using a balloon-borne magnetic spectrometer. These measurements fill a gap in the previously existing data and permit the determination of the interstellar spectra of cosmic-ray positrons and electrons. Knowledge of these spectra provides a crucial tool for studies of the distribution and density of matter and magnetic fields in the interstellar medium and the origin and dynamics of energetic particles contained in the fields. The differential energy spectrum of interstellar electrons may be represented as a power-law, j alpha T to the -1.8 power for 100 MeV $\lesssim T \lesssim 2$ GeV, but must flatten considerably at lower energies. From the measured electron charge composition, it is concluded that the majority of cosmic-ray electrons with energies above approximately 10 MeV originate in primary sources. (auth) (STAR)

21995 DIFFUSE COSMIC γ RADIATION BETWEEN 5 MeV AND 20 MeV. Kuo, F. S. Cleveland, OH; Case Western Reserve Univ. (1973). 158p. University Microfilms Order No. 74-10,801.

Thesis (Ph. D.).

Measurement of diffuse cosmic γ rays between 5 and 20 MeV near the top of the Earth's atmosphere is reported for a balloon

flight from Palestine, Texas on August 19, 1968. Only the electron–positron pairs with their apparent opening angles smaller than 76.4° were analyzed. The efficiencies of the spark chamber at different energies and different incident angles were calculated by Monte Carlo simulations. An accelerator calibration was made at E_γ = 12 MeV and incident angle ≃ 5° to check the Monte Carlo calculation. The consistency between the Monte Carlo simulation and the accelerator calibration was better than 20%. The efficiency of the spark chamber had a maximum at 11 MeV and a FWHM of 8 MeV. Therefore the response of the spark chamber was not sensitive to the shapes of the incident γ-ray spectra. The flux of the diffuse cosmic γ rays at 10 MeV was determined to be $(8.0 \pm 4.5) \times 10^{-4}$ photons/(MeV cm^2 sec sr), where the uncertainty was not the usual statistical error but was imposed by the uncertainty in the subtraction of the atmospheric background. (Diss. Abstr. Int., B)

21996 MEASUREMENT OF THE HIGH ENERGY PION FLUX AT THE DEPTH OF THE ATMOSPHERE. Shestoperov, V. Ya. (Moscow State Univ.). Yadern. Fiz.; 19: No. 6, 1282-1289(Jun 1974). (In Russian).

The method used in the cosmic rays to determine the high energy pion flux by measuring the ratio of charged to neutral hadrons is analyzed. It is shown that this method can result in large errors if (as it was made in all previous papers) the restriction is imposed on the showers accompanying the hadrons. (auth)

21997 MEASUREMENT OF THE ABSOLUTE VERTICAL MUON FLUX BETWEEN 0.76 GeV/c AND 1.25 GeV/c. Ng, L. K.; Thompson, M. G.; Whalley, M. R. (Univ. of Durham, Eng.). Nuova Cim.; 22B: No. 2, 328-336(11 Aug 1974).

With the aid of a range spectrograph the differential and integral muon intensities at sea level were measured. The differential intensities at (0.85 ± 0.03) GeV/c and (1.16 ± 0.04) GeV/c were $(4.09 \pm 0.21) \cdot 10^{-6}$ cm^{-2} s^{-1} sr^{-1} (MeV/c)$^{-1}$ and $(3.29 \pm 0.19) \cdot 10^{-6}$ cm^{-2} s^{-1} sr^{-1} (MeV/c)$^{-1}$ respectively. These measurements confirm the recent results of Allkofer et al. at similar muon momenta, and suggest that the differential muon momentum spectrum below 5 GeV/c is slightly steeper than has hitherto been believed. (auth)

21998 SOLAR MODULATION OF GALACTIC PROTONS, He NUCLEI AND ELECTRONS DURING 1965–1968. Cecchini, S.; Guidi, L.; Martinic, N. J. (CNR, Bologna). Nuovo Cim.; 22B: No. 2, 237-248(11 Aug 1974).

The Fokker–Planck equation describing the steady-state transport of galactic particles into the interplanetary medium is integrated numerically and conditions for the time variation of the solar modulation during 1965–1968 are presented. Assuming a spherically symmetric geometry the diffusion coefficient is considered to be expressed by $K(r,P,t) = K_1(r,t)K_2(P,t)$. The radial dependence of K_1 and the rigidity dependence of K_2 is discussed in order to explain the modulation for all types of galactic particles considered. The calculated modulation parameters and near-Earth spectra are shown; they seem to be in satisfactory agreement with the relative experimental data. (auth)

21999 COSMIC RADIATION DOSIMETRY FROM THE SUPERSONIC AIRCRAFT, CONCORDE. Francois, H. (CEN, Fontenay-aux-Roses, France); Portal, G.; Delahaye, R. P.; Simon, P.; Kaiser, H.; Durney, P. Radioprotection; 8: No. 3, 207-218(1973). (In French).

Dosimetry of radiation on-board the French prototype supersonic transport Concorde 001 was performed during the aircraft's test flights from its Toulouse base. The Supersonic Transport Medical Subcommittee of the General Secretariat for Civil Aviation directed these radiation measurement activities. Actual dosimetric operations were conducted by different specialized laboratories employing the following systems and techniques: passive integrator dosimetric systems (nuclear emulsions in which each event is individually analyzed, stacks of nuclear emulsions of varying sensitivity which permit obtaining ionizing-particle distribution as a function of their LET, radiothermoluminescent dosimeters, fast-neutron dosimeters): dose-rate recording systems. The results are analyzed and compared. In addition, the dosimetric problems posed by possible solar flares and their effects upon flight plans are discussed. Conclusions are drawn relative to the possible dosimetry techniques to be employed in identifying radiation protection problems on-board the SST. (FR)

22000 GEOMAGNETIC PULSATIONS AS A POSSIBLE CAUSE OF COSMIC RAY MICROVARIATIONS. Saito, T. (Tohoku Univ., Sendai). Uchusen Kenkyu; 18: No. 1, 24-40(Aug 1973).

The periodic rapid variation of magnetic field in earth's magnetosphere is reviewed as one of the causes of the microvariation of cosmic ray. The geomagnetic pulsation including that with period shorter than 100 seconds was classified at the 1963 Berkeley Assembly of IAGA. However, many characteristic subtypes have been reported afterwards, and it was found that it is difficult to sort them into the existing classification. The present classification is made on the basis of dynamic spectral pattern and probable occurrence mechanism. Continuous and irregular pulsations may correspond roughly to horizontal-structure type or vertical-structure type from the spectral point of view, or roughly to resonance-oscillation type and forced oscillation type from the point of view of excitation mechanism, respectively. Since the microvariation of cosmic ray which has been reported and discussed so far has the period ≳100 seconds, the subtypes of geomagnetic pulsation with the period >100 seconds are individually reviewed. The effect of the pulsation P_T with the period of 200 and 500 seconds might be the largest. The method for the spectral analysis of geomagnetic pulsations is introduced as an information for the spectral analysis of cosmic ray microvariation. (JA)

22001 PULSED ELECTRIC FIELD AS A MEANS OF REMOVING STRONG BACKGROUNDS IN STUDIES OF MULTIPLY CHARGED PARTICLES IN NUCLEAR EMULSIONS. Akopova, A. B.; Magradze, N. V. Cosmic Res. (USSR) (Engl. Transl.); 11: No. 5, 722-723(1973).

Translated from Kosm. Issled.; 11: No. 5, 801-803(1973).

An attempt was made to obtain useful information by using conventional chemical development, subject only to the preliminary application of some agent ensuring that only the heavy-particle tracks remain in the emulsion and all others are suppressed. The agent was in this case an electric field. (MHR)

22002 PYL' V ATMOSFERE I OKOLOZEMNOM KOSMICHESKOM PROSTRANSTVE. (Dust in the Atmosphere and the Near-Earth Cosmic Space). Divari, N. I. (ed.). Moscow; Izdatel'stvo Nauka (1973). 212p.

Such topics as the motion of gravitating charged particles in a spiral magnetic field, the influence of the earth on dust-particle motion in interplanetary space, the zodiacal component at the pole of the ecliptic, and the application of the Monte Carlo method to the formation of meteor streams are discussed. Optical sounding methods are discussed, and the possibility of studying the upper atmosphere by the twilight method and by a method based on the observation of satellites as they enter the earth's shadow is examined. Individual items are announced in this issue. (IAA)

22003 FLARE OF COSMIC GAMMA RADIATION AS OBSERVED WITH COSMOS-461 SATELLITE. Mazets, E. P.; Golenetskii, S. V.; Il'inskii, V. N. (Ioffe Inst. of Physics and Tech., Moscow). JETP Lett. (USSR) (Engl. Transl.); 19: No. 2, 77-78(20 Jan 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 19: No. 2, 126-128(20 Jan 1973).

Results are presented of a cosmic gamma-radiation flare observed on 17 January 1972. (auth)

Stars

Refer also to abstracts 22079 and 22797.

22004 (N-74-10757) GAMMA-RAY BURSTS DURING NEUTRON STAR FORMATION. Gamma-ray Bursts and Transient X-Ray Sources. Cohen, J. M.; Desai, U. D.; Holt, S. S. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). Oct 1973. 7p. (NASA-TM-X-70510). NTIS $3.00.

Discussions are presented at the associations between cosmic gamma-ray bursts and transient x-ray sources, and the release of gravitational binding energy during the formation of neutron stars. The model for studying the associations is described along with the release of neutrinos during the collapse of white dwarfs. (STAR)

22005 LIGHT SCATTERING IN A HOMOGENEOUS SPHERE. Sobolev, V. V. (Leningrad State Univ.). Astrophysics (Engl. Transl.); 8: No. 2, 117-127(1972).

Translated from Astrofizika; 8: No. 2, 197-212(1972).

Formulas are obtained for the mean number of photon scatterings in a sphere and the sphere's luminosity for arbitrary energy sources. These quantities are expressed in terms of the resolvent function $\Phi(\tau)$ for a plane layer. Three types of energy source are considered in particular: (1) uniform distribution of sources; (2) the sphere illuminated with parallel beams; (3) a point source situated at an arbitrary distance from the center of the sphere. (auth)

22006 INCOHERENT SCATTERING. III. Engibaryan, N. B.; Nokogosyan, A. G. (Inst. of Mathematics, Erevan). Astrophysics (Engl. Transl.); 8: No. 2, 128-136(1972).

Translated from Astrofizika; 8: No. 2, 213-225(1972).

Radiative transfer within a spectral line in an isothermal medium was studied. Various systems of functional equations were derived for auxiliary functions that generalize the well-known functions φ and ψ of Ambartsumyan. Knowledge of these functions enables one to determine the coefficients of reflection and transmission and also the radiation field within the medium. (auth)

22007 POSSIBILITY OF ACCELERATING MATTER IN HOT STARS BY ABSORPTION IN SPECTRAL LINES. Malov, I. F. (Lebedev Inst. of Physics, Moscow). Astrophysics (Engl. Transl.); 8: No. 2, 137-140(1972).

Translated from Astrofizika; 8: No. 2, 227-233(1972).

Maximal values are obtained for the momentum that can be transferred from radiation to matter in the case of absorption in spectral lines in the atmospheres of Wolf-Rayet stars and OB supergiants. On the basis of these estimates it is shown that the maximal rate of mass loss due to absorption of radiation in lines is approximately an order of magnitude less than the observational estimates, from which it follows that the acceleration mechanism associated with this absorption does not play a decisive role in the observed loss of matter from Wolf-Rayet stars and OB supergiants. (auth)

22008 DIFFUSION OF RADIATION IN A STELLAR SHELL EXPANDING WITH CONSTANT VELOCITY. Vityazev, V. V. (Leningrad State University). Astrophysics (Engl. Transl.); 8: No. 2, 141-147(1972).

Translated from Astrofizika; 8: No. 2, 235-245(1972).

In the one-dimensional approximation a study is made of the problem of the diffusion of radiation in two layers that move relative to each other with constant velocity. It is assumed that there is a complete redistribution in frequency of the radiation in an elementary volume. For the case of finite layers a numerical method yields the source function, the intensity of the emerging radiation, and the force of the light pressure when the absorption coefficient has a Doppler profile. In the case of semiinfinite layers, equations are derived for the intensity of the emerging radiation as well as an exact formula for the source function. (auth)

22009 NATURE OF THE FLARE RADIATION OF UV CETI STARS. Korovyakovskaya, A. A. (Special Astrophysical Observatory, Moscow). Astrophysics (Engl. Transl.); 8: No. 2, 148-156 (1972).

Translated from Astrofizika; 8: No. 2, 247-260(1972).

A study was made of the de-excitation of the ionized hydrogen gas behind a shock front propagating in a polytropic medium. The theoretical light curves for the gas and those observed for flares of UV Ceti stars were in satisfactory agreement. Graphs are given that characterize the change in time of the electron and ion temperatures, the degree of ionization and excitation, and the number of L_α photons behind the shock front for different initial conditions in the medium. (auth)

22010 EVOLUTION OF A WHITE DWARF WITH ACCRETION OF HYDROGEN-RICH MATTER. Redkoborodyl, Yu. N. (Principal Astronomical Observatory, Moscow). Astrophysics (Engl. Transl.); 8: No. 2, 157-169(1972).

Translated from Astrofizika; 8: No. 2, 261-282(1972).

A study was made of the evolution of a helium white dwarf with a hydrogen envelope that increases uniformly as a result of accretion. The calculations were made on the basis of Henyey's method under the assumption of quasistatic accretion. An evolutionary sequence of models was constructed; this indicates that a thin shell in which there is a thermally unstable energy source arises in the lower layers of the hydrogen envelope. It is shown that there is an enhanced growth of the temperature in this layer of hydrogen burning even after the accretion rate may have ceased abruptly for any reason provided the mass of the accumulated hydrogen exceeds a certain critical value. These results can be related to the phenomena of novae and repeated and dwarf novae found in close double systems. (auth)

22011 ATMOSPHERES OF NONROTATING BARYON STARS. Saakyan, G. S.; Sedrakyan, D. M. (Erevan State Univ.). Astrophysics (Engl. Transl.); 8: No. 2, 170-177(1972).

Translated from Astrofizika; 8: No. 2, 283-293(1972).

A model is proposed for the atmosphere of hot baryon stars; this consists of a proton–electron gas and radiation. For luminosities $L \approx 1.3 \cdot 10^{38}$ erg/sec, $M = M_\odot$, $R \approx 10$ km, and surface temperature $T_R \approx 2 \cdot 10^7$°K, a fairly extended atmosphere is obtained: at the surface of the star the particle density is $n \approx 7 \cdot 10^{18}$ cm^{-3}, and at 10^3 km it is $n \approx 7 \cdot 10^{12}$ cm^{-3}. It would seem that pulsars have such an atmosphere. (auth)

22012 PHASE MIXING OF THE SECOND KIND IN STELLAR SYSTEMS. II. Osipkov, L. P. (Leningrad State Univ.). Astrophysics (Engl. Transl.); 8: No. 2, 178-183(1972).

Translated from Astrofizika; 8: No. 2, 295-304(1972).

Mixing of the second kind is investigated for the case when the phase space of the system can be represented as a series of tori embedded in one another. Geometrical arguments allow one to estimate the characteristic time of mixing of the second kind. It can be shown that for stars in spherical systems moving in strongly elongated orbits with a high energy, mixing occurs in a time of order $(L^3/8GM)^4$, where L is a characteristic width of the system and M is its mass. For systems that allow the Lindblad–Oort integral, vertical mixing does not occur. (auth)

22013 VELOCITY VARIATION OF STARS AS A PURELY DISCONTINUOUS RANDOM PROCESS. III. Stars of Different Masses in an Open Cluster. Kaliberda, V. S.; Petrovskaya, I. V. (Leningrad State Univ.). Astrophysics (Engl. Transl.); 8: No. 2, 184-188(1972).

Translated from Astrofizika; 8: No. 2, 305-313(1972).

Assuming a purely discontinuous random process, the evolution of the velocity distribution function of a group of stars in an open cluster was studied. The mass of a considered star was assumed equal to half the mean mass of a star in the cluster. Numerical solution of the second Kolmogorov–Feller equation yielded the velocity distribution function of stars of the considered group at different times and also the rate of escape of these stars and the energy they carry away. The results obtained in the framework of a purely discontinuous random process for a quasistationary state were compared with the solution of the Fokker–Planck equation (continuous random process) of Spitzer and Harm. (auth)

22014 SPECTRUM OF CH CYGNI FROM 1961 TO 1973. Deutsch, A. J. (Hale Observatories, Pasadena, CA); Lowen, L.; Morris, S. C.; Wallerstein, G. Publ. Astron. Soc. Pac.; 86: No. 511, 233-236(Jun 1974).

Radial velocities of absorption lines from 30 spectrograms taken between 1964 and 1973 yield no evidence of orbital motion. Evidence is presented that a circumstellar envelope is always present and that an "outburst" occurs when the envelope is excited by a disturbed region on the surface of the star. Some comparisons are made of CH Cyg with the VV Cephei stars, symbiotic objects, and the symbiotic long-period variable R Aqr. (auth)

22015 REGION OF THE K LINE IN THE SPECTRUM OF β LYRAE. Batten, A. H.; Diamond, G. L.; Fisher, W. A. (Dominion Astrophysical Observatory, Victoria, B. C.). Publ. Astron. Soc. Pac.; 86: No. 511, 237-240(Jun 1974).

High-dispersion spectrograms of β Lyr obtained at the Hale and Dominion Astrophysical Observatories were examined in a search for the secondary component of the K line. No such component could be certainly detected. (auth)

22016 LUMINOSITIES AND MOTIONS OF PECULIAR B-TYPE STARS. Eggen, O. J. (Australian National Univ., Canberra). Publ. Astron. Soc. Pac.; 86: No. 511, 241-262(Jun 1974).

The luminosities of peculiar A- and B-type stars with well-determined apparent motions were obtained from a calibration of intermediate-band photometry. This calibration was derived from members of the Pleiades group and extended to all stars brighter than visual magnitude 6.5. Some 15% of the B-type stars in the Pleiades group are peculiar. The incidence of spectroscopic binaries is also discussed. (auth)

22017 DL VIRGINIS: AN ECLIPSING BINARY AS PART OF A TRIPLE SYSTEM. Schoeffel, E. (Remeis Sternwarte, Bamberg, Ger.); Popper, D. M. Publ. Astron. Soc. Pac.; 86: No. 511, 267-271(Jun 1974).

The A-type eclipsing binary, DL Vir, period 1.3d, shares a common center of mass with a G8 giant, their period being in the vicinity of 2500d, with a large uncertainty. The eclipsing companion is not visible in the spectrum, although the disappearance of the A-type lines at primary minimum shows that the eclipse is total. The short-period, single-lined binary orbit is fairly well determined. Only a crude estimate of the mass of the late-type giant can be derived from the available data. (auth)

22018 CONTINUOUS SPECTRUM OF HD 184927. Higginbotham, N. A. (Louisiana State Univ., Baton Rouge); Schiffer, F. H. III; Dufour, R. J. Publ. Astron. Soc. Pac.; 86: No. 511, 272-275(Jun 1974).

New spectrophotometric scans from λ3390 to λ5840 are presented for the helium-rich star HD 184927. An apparent effective temperature is determined by comparing the unreddened continuum with continua predicted by model atmospheres. Both the scans and

the effective temperature are found to be in discordance with previously published results. (auth)

22019 ALUMINUM OXIDE IN STELLAR SPECTRA: AN INFRARED ELECTRONIC TRANSITION. Luck, R. E.; Lambert, D. L. (Univ. of Texas, Austin). Publ. Astron. Soc. Pac.; 86: No. 511, 276-278(Jun 1974).

The possibility of detecting the infrared electronic transition $A^2\Pi_i - X^2\Sigma^+$ of AlO in spectra of cool stars is reviewed. It is shown that the transition may be of importance in Mira-type variables. Additional laboratory investigation of the transition is needed. (auth)

22020 BDS 1269: A POSSIBLE PHYSICAL PAIR WITH A METAL-DEFICIENT PRIMARY. Mechler, G. E. (Case Western Reserve Univ., Cleveland). Publ. Astron. Soc. Pac.; 86: No. 511, 279-280(Jun 1974).

The brighter component of BDS 1269 has four-color and Hβ indices characteristic of a metal-deficient star, while the indices of the secondary are those of a normal early F-type star. The primary may be (1) a horizontal-branch star, and, if so, the brightest known, (2) the only such star physically associated with a normal population I object, and (3) slightly variable. (auth)

22021 DETECTION OF LITHIUM IN THE dMle STAR GLIESE 182. Bopp, B. W. (Univ. of Texas, Austin). Publ. Astron. Soc. Pac.; 86: No. 511, 281-283(Jun 1974).

The results of a search for the λ6707 lithium line in several flare and dMe stars are reported. Of 14 stars surveyed, 13 have no detectable lithium (EW(λ6707) $\lesssim$ 50 m$\AA$). However, one star, Gliese 182, has the line present with EW ~200 m$\AA$. In other respects this star seems a normal Me dwarf: the kinematics are not peculiar, and a well-determined parallax places it on the main sequence. It is noted that basic astronomical data for Gliese 182 are solely lacking. (auth)

22022 OPEN CLUSTER NGC 6281. Feinstein, A.; Forte, J. C. (Univ. Nacional, La Plata). Publ. Astron. Soc. Pac.; 86: No. 511, 284-288(Jun 1974).

Stars in the field of NGC 6281, including the bright star HD 153919, were observed photoelectrically in the UBV system. A distance of 560 ± 30 parsecs, a mean reddening of $E_{B-V} = 0.15m \pm 0.02$, and an estimated age of 10^8 years were derived for cluster members. Possible light variations of the star HD 153919, recently identified as an x-ray source are noted. (auth)

22023 FIVE-COLOR PHOTOMETRY OF NEARBY RED DWARFS. II. Upgren, A. R. (Wesleyan Univ., OH). Publ. Astron. Soc. Pac.; 86: No. 511, 294-295(Jun 1974).

Photoelectric photometry is given for 46 stars in the (R − I) color index on the Kron system and in the standard UBV color indices. Most stars are nearby K and early M dwarfs selected from the McCormick lists for which a trigonometric parallax is determined by the astrometric program of the Van Vleck Observatory. This list constitutes part of a program to obtain five-color photometry of all stars included in the Van Vleck parallax program. (auth)

22024 ULTRAVIOLET PHOTOMETRY OF THE SUPERNOVA (1972) IN NGC 5253. Holm, A. V.; Wu, C. C.; Caldwell, J. J. (Univ. of Wisconsin, Madison). Publ. Astron. Soc. Pac.; 86: No. 511, 296-303(Jun 1974).

The supernova (1972) in NGC 5253 was observed with the wide-band filter photometers of OAO-2 between 1972 May 20 and 1972 July 22. Initially the ultraviolet colors of supernova resembled those of an F supergiant star. The last observations revealed that the 2460 Å flux was greater than expected from a stellar photosphere. During the 63 days of OAO-2 observations the energy radiated between 4250 Å and 2460 Å to be 2.9×10^{48} ergs was measured. Only 30% of this energy was radiated shortward of 3320 Å. From the OAO-2 observations and published ground-based data the minimum total radiated energy of the supernova was estimated to be 7×10^{49} ergs. (auth)

22025 BM SCORPII AND A POSSIBLE CLUSTER OF INFRARED SOURCES. Ney, E. P.; Humphreys, R. M. (Univ. of Minnesota, Minneapolis). Publ. Astron. Soc. Pac.; 86: No. 511, 304-307(Jun 1974).

BM Sco and six other infrared sources near the cluster M6 were observed at infrared wavelengths. BM Sco has the flat free-free spectrum between 1.5 μ and 8 μ with a small silicate emission feature typical of the NML Tauri-type objects. IRC−30308 is also an infrared star of the NML Tauri type, and IRC−30312 has long wavelength radiation characteristic of the luminous M supergiants. The remaining four sources resemble reddened long-period variables. The presence of these infrared sources near M6 is not statistically significant and is not sufficient to associate them with the cluster. (auth)

22026 LR SAGITTARII. Vidal, N. V. Publ. Astron. Soc. Pac.; 86: No. 511, 308-310(Jun 1974).

The identification and recent brightening of LR Sgr are discussed. A spectrum taken in its bright phase shows a faint Hα line in emission. (auth)

22027 BV PHOTOMETRY OF GLOBULAR CLUSTERS IN M87. Ables, H. D. (Naval Observatory, Flagstaff, AZ); Newell, E. B.; O'Neil, E. J. Jr. Publ. Astron. Soc. Pac.; 86: No. 511, 311-316(Jun 1974).

Electrographic BV photometry is presented for 86 faint objects around M87. Comparison of the electrographic measurements with the photographic measurements of Racine and Hanes (Hanes 1971) indicates a possible radial dependence in the photographic magnitudes and colors inside a radius of 4′ centered on M87. For objects outside a radius of 4′, the electrographic and photographic V magnitudes are in agreement but the electrographic B magnitudes are systematically fainter than the photographic B magnitudes by about 0.2m. For a subset of 22 objects a comparison of the electrographic and photographic (B − V) color indices shows the average electrographic (B − V) color index to be larger by 0.14m. Correction of Hanes' average (B − V) color index by this amount gives $(B - V)_{eg} = 0.79$ for the globular clusters in M87. (auth)

22028 STELLAR CONTINUUM FEATURE NEAR 8800 Å. Oinas, V. (Univ. of Nebraska, Lincoln). Publ. Astron. Soc. Pac.; 86: No. 511, 321-323(Jun 1974).

Detailed spectrophotometric scans of stars covering a wide range in spectral type reveal a wide absorption feature near 8800 Å, appearing in stars of type F and increasing in strength with decreasing temperature. No satisfactory explanation has been found for the feature. (auth)

22029 SPECTROPHOTOMETRY OF STARS OF THE PLEIADES CLUSTER. II. Absorption Lines. Vykhrestyuk, T. P.; Karetnikov, V. G. Astrometriya Astrofiz.; No. 20, 13-18(1973). (In Russian).

The equivalent widths of the spectral lines of hydrogen and K Ca II were determined on the basis of the spectrograms of 57 stars in the Pleiades Cluster and electron densities in stellar atmospheres were calculated by the methods of Inglis − Teller and Unsold. Dispersion of spectrograms was 166 Å/mm at H_γ. Comparison of the obtained values with the characteristics of "normal" stars was made. There was not good agreement in some cases. (auth)

22030 DETERMINATION OF TITANIUM OXIDE AND ATOMIC OXYGEN ABUNDANCES IN THE ATMOSPHERES OF THE M-TYPE STARS. Shavrina, A. V. Astrometriya Astrofiz.; No. 20, 10-12(1973). (In Russian).

The abundance of titanium oxide in the atmospheres of five M-stars (α Sco, δ^2 Lyr, R Lyr, α Her A, and β Peg) was determined from the profile of the (0,1) band head of TiO v-system. The atomic oxygen concentration was obtained from the dissociation equilibrium equation for α Sco, R Lyr, α Her A, and β Peg, for which reliable values of TiI abundances are available. (auth)

22031 ONE NEW CHARACTERISTIC OF INTRINSIC STELLAR VARIABILITY. Lukatskaya, F. I. Astrometriya Astrofiz.; No. 20, 3-9(1973). (In Russian).

V, B and U, B relations for simultaneous UBV individual stellar flares reveal differences in the composition of radiation on the ascending and descending branches of the flares. The flares of SS Cyg and secondary maxima of N Del 1967 have smaller B magnitudes at the descent of brightness than at the rise for the given value of the V magnitude intermediate between maxima and minima. In the same manner, the U magnitudes are smaller on the descending branch for the same B magnitude. At the same time the shifts of the V, B and U, B relations for two flares of UV Ceti variables, Z And flare and pulsating variables are of an opposite character. Radiation on the descending branches are considered as a sum of ascending and additional radiations. The latter is called "residuals." U−B and B−V color-indices of residual radiations are determined. (auth)

22032 EFFECTS OF RAPID, DIFFERENTIAL ROTATION ON THE SPECTRA OF WHITE DWARFS. Milton, R. L. Santa Cruz, CA; University of California (1973). 151p. University Microfilms Order No. 73-32,501.

Thesis (Ph. D.).

There have been several studies on the effects of rotation, both uniform and differential, on the interior structures of white

dwarfs. The only study of the effects of rotation on the emergent spectra has been for the case of uniform rotation. The present work is a study of the effects of differential rotation on the emergent spectra of white dwarfs. In order to make this study, it is necessary to calculate the specific intensities for a grid of nonrotating model atmospheres of varying effective temperature and gravity. The models were calculated for a hydrogen abundance of 90% by number and include the effects of both line-blanketing due to the hydrogen lines and convection. The calculations were made using a modified Avrett–Krook procedure with the assumption of LTE. These nonrotating models were then fitted to the surface of the rotating interior models, taking into account the variation of the effective temperature (calculated using von Zeipel's theorem) and gravity with co-latitude and the Doppler wavelength shifts due to the surface rotational velocities. The models calculated have luminosities a few per cent of that of the Sun. The resulting spectra can be divided into three classes: (i)—those indistinguishable from spectra of nonrotators, similar to the DA white dwarfs; (ii)—those with markedly shallow hydrogen lines, similar to the DAwk white dwarfs; and (iii)—those without detectable lines, similar to the DC white dwarfs. Thus, unlike the case of uniform rotation, it is possible to generate spectra like those of DC white dwarfs from hydrogen rich models using differential rotation. Such spectra can occur over a wide range of viewing angles. The large masses required, plus the ease of generating lineless spectra for objects outside the color range of the observed DC white dwarfs, make it seem unlikely that all the DC's can be explained in this fashion, though some DC's may be this type of object. (Diss. Abstr. Int., B)

22033 REMARKS ON THE THEORETICAL CONTINUOUS SPECTRA OF O AND B STARS. Krikorian, R. (CNRS, Paris). Compt. Rend., Ser. B; 278: No. 4, 131-133(21 Jan 1974). (In French).

Results obtained using nonlocal thermodynamic equilibrium models for O and B stars are compared with Chalonge–Divan observations, the Balmer D discontinuity and $\Delta\Phi_0$ parameter being used as criteria. (FR)

22034 RAPID VARIABLE STARS WITH Sd B SPECTRAL CHARACTERISTICS. Lukatskaya, F. I. Astrometriya Astrofiz.; No. 16, 100-112(1972). (In Russian).

Statistical analysis was carried out for the light observations of ten rapid irregular variables with SdB spectral characteristics and for R Aqr and Sco X-1. Both the types and the parameters of stochastic processes which simulate the light variations were determined. Dependences were found between parameters and some physical characteristics of variables. Sco X-1 is similar to nova-like stars with respect to the results of statistical analyses of light variations. (auth)

22035 THERMODYNAMICS OF WHITE DWARF MATTER IN CRYSTALLINE PHASE. De Cesare, L.; Foriani, A. (Osservatorio Astronomico, Naples). Soc. Astron. Ital., Mem.; 44: 13-22(1973).

The thermodynamic functions of white dwarf matter in crystalline phase are constructed at temperatures and densities characteristic of the interiors of white dwarfs and of neutron star crusts. The model employed is a heavy-ion plasma forming a bcc lattice immersed in a uniform neutralizing background of nonrelativistic and relativistic strongly degenerate electrons. (auth) (IAA)

22036 TWO HIGH GALACTIC LATITUDE STARS OF THE TENTH MAGNITUDE, RICH IN IONIZED HELIUM AND VERY DEFICIENT IN HYDROGEN. Berger, J.; Fringant, A. M.; Rebeirot, E. (CNRS, Paris). Compt. Rend., Ser. B.; 278: No. 6, 227-230(4 Feb 1974). (In French).

The two stars, BD 48° 1777 and BD 37° 1977, have spectra characterized by intense He II absorption lines and the apparent absence of hydrogen. The first of these stars is a sub-dwarf of the BD 75° 325 type, while the second is not under-luminous and bears strong similarity with BD 37° 442. (FR)

22037 MODIFICATION OF THE LAFLER–KINMAN–KHOLOPOV METHOD FOR DETERMINING THE PERIOD OF BRIGHTNESS VARIATION IN VARIABLE STARS. Grigorevskii, V. M.; Vykhrestiuk, S. S.; Belotserkovyskii, B. E.; Petrov, M. P.; Yanov, V. N. Astrometriya Astrofiz.; No. 19, 118-127(1973). (In Russian).

22038 FITTING PROCEDURE FOR CONDUCTIVE OPACITY IN A STELLAR MEDIUM. Bouvier, P.; Patenaude, M. (Geneve Observatoire, Sauverny, Switzerland). Arch. Sci. (Geneva); 26: 119-131(1973).

An expeditious although sufficiently accurate procedure is proposed to include the conductive opacity into the overall opacity of the stellar medium, according to the most recent advances in the theory of electron conduction. The method has been successfully tested in a case where previously tabulated opacity values were available. (auth) (IAA)

22039 CHEMICAL COMPOSITION OF THE ATMOSPHERES OF THE M SUPERGIANTS ALPHA SCO AND ALPHA HER A. Shavrina, A. V.; Yakovina, L. A. Astrometriya Astrofiz.; No. 19, 87-98(1973). (In Russian).

22040 PHOTOMETRIC STUDIES OF RED STARS. Balklavs, A. E. Riga; Izdatel'stvo Zinatne (1973). 191p. (In Russian).

The photographic photometry of carbon stars and of 12 red stars, main-sequence star masses, the spectral class-mass relationship, and some photomultiplier characteristics are among the topics covered in papers concerned with various aspects of photometric investigations of red stars. Other topics covered include an improved method for the determination of extinction in stellar photoelectric photometry, an investigation of the quality of the optics of a Schmidt telescope; and the suitability of a Schmidt telescope for stellar photometry. (IAA)

22041 PHOTOGRAPHIC PHOTOMETRY OF CARBON STARS. Alksnis, A. K.; Alksne, Z. K.; Daube, I. A. pp 7-113 of Photometric Studies of Red Stars. Riga; Izdatel'stvo Zinatne (1973). (In Russian).

Photographic photometry observations are presented on 59 R, V, B carbon stars, obtained with the aid of a 80/120/240 cm Schmidt telescope camera in six regions of the Milky Way. These observations, continued over a period of three years, show 44 of the observed carbon stars to be of varying brightness. The highest carbon star variability percentage was found in the direction along the spiral arm in Cygnus, and the lowest percentage in the vicinity of the NGC 1664 galactic cluster near the anticenter direction. (IAA)

22042 MAIN-SEQUENCE STAR MASSES AND THE MASS-SPECTRAL CLASS CORRELATION. Dzervitis, U. K. pp 131-147 of Photometric Studies of Red Stars. Riga; Izdatel'stvo Zinatne (1973). (In Russian).

Data on the mass values of main-sequence visual binaries and eclipsing variables are presented, along with a diagram of main-sequence star mass versus spectral class. The zero-age main-sequence line appears on the diagram as an envelope. (IAA)

22043 PHOTOVISUAL PHOTOMETRY OF SEMIREGULAR AND IRREGULAR CARBON STARS. Krempec, J. (Obserwatorium Astronomiczne, Torun, Poland). Astronomie; 5: No. 2, 19-35(1973).

Photovisual photometry data recently obtained at the Torun Observatory on twenty semiregular and irregular carbon stars are presented, along with their photovisual light curves. The photometric data are shown together with those of other observers, and all available published photometric data for each star are briefly reviewed. (IAA)

22044 STATISTICAL POPULATION INDICES OF PLANETARY NEBULAE. Iwanowska, W. (Obserwatorium Astronomiczne, Torun, Poland). Astronomie; 5: No. 2, 1-9(1973).

Statistical population indices for planetary nebulae were redetermined using new distance values published by Cahn and Kaler (1971). The coefficients of correlation between statistical population indices and the abundance ratios He/H and O/H compiled by Kaler (1970) were calculated. No significant correlation was found for He/H ratio, a positive correlation for O/H ratio was established—i.e., O/H is higher for population I nebulae. (auth) (IAA)

22045 SPECTROPHOTOMETRY OF THE PLEIADES STAR CLUSTER. I. Continuous Spectrum. Vykhrestiuk, T. P.; Karetnikov, V. G. Astrometriya Astrofiz.; No. 19, 110-118(1973). (In Russian).

Spectrophotometric gradients and Balmer discontinuities calculated for 44 Pleiades cluster stars on the basis of spectrograms are reviewed. A comparison of the computation results with "normal" gradient values led, after determination of the light absorption characteristics, to a division of the 44 stars into reddened and nonreddened star groups. Most of the stars showed no anomalies in the continuous spectrum. (IAA)

22046 W-URSA-MAJOR STARS. Mauder, H. (Univ., Tuebingen, Ger.). Sterne Weltraum; 12: 252-255(Sep 1973). (In German).

The W-Ursa-Major (W UMa) stars form an important group of the eclipsing variables. The general catalog of variable stars contains 374 eclipsing variables of the type W UMa. It is estimated that the total number of stars of this type in the Galaxy is much higher. The Roche model for binaries is discussed together with

observational data regarding W UMa stars and the model of a "common convective envelope." Theoretical model concepts are compared with the observations. (IAA)

22047 UNSTABLE ECLIPSING GIANT SYSTEM RZ CANCRI. Broglia, P.; Conconi, P. (Osservatorio Astronomico, Milan). Soc. Astron. Ital., Mem.; 44: 87-100(1973).

U, B, V light curves of the late giant eclipsing system RZ Cnc have been obtained during the years from 1959 to 1967. The period seems constant. The system is intrinsically variable to a small degree. The photometrically unstable region is not visible during the central phases of the primary eclipse, as for the Ca II emission, so it belongs to the brighter star. Some solutions have since been calculated by means of an 1620 IBM computer, for different limb darkening coefficients and taking the primary minimum alone or both the minima. The lighter component fills its Roche lobe. (auth) (IAA)

22048 DETECTION OF MASS LOSS FROM THE DWARF NOVA Z CAMELOPARDALIS. Robinson, E. L. (Univ. of Texas, Austin). Astrophys. J.; 186: No. 1, 347-356(15 Nov 1973).

A series of image-tube spectra of the Hα emission line from the dwarf nova Z Cam has been acquired. The wings of the Hα profile have been used to obtain an improved orbital radial-velocity curve for the blue component of the binary system, and thus to obtain improved orbital elements. The center of the Hα profile displays a triple-peaked structure. This structure does not partake of the orbital radial-velocity variations of the underlying emission line, and must be formed in an expanding circum-system shell. The shell appears to be formed by continuous mass loss rather than by mass ejection during eruptions. A mass-loss rate greater than 2.4×10^{-9} $M_\odot$ yr^{-1} is deduced, which is probably sufficient to affect seriously the evolution of the Z Cam system. (auth)

22049 ENERGY OF NEUTRON-STAR MATTERS. Moszkowski, S. A. (Univ. of California, Los Angeles). Phys. Rev., D; 9: No. 6, 1613-1625(15 Mar 1974).

It is generally believed that the interior of some neutron stars is dense enough that the neutron-star matter (NSM) contains not only neutrons, but also protons, electrons, and various hyperons. In the present paper we calculate the effect of some hyperons on the composition and energy of the NSM. We calculate the energy per baryon and the fractions of the various baryons present, as a function of the baryon density, ranging from 0.1 to 2 baryons per fm^3, using two slightly different modifications of the Reid-soft-core interaction, one developed by Sawada and Wong, and the other by Campi and Sprung. The interaction energies are based on reaction matrix calculations by the above authors. We consider first a pure neutron gas. However, even at subnuclear densities ($\leq$0.15 baryons per fm^3) it is generally agreed that there are protons present (and also electrons to keep the system neutral). We calculate the effect of the protons (which constitute less than 10% of the baryons) on the energy. We then study the effect of what, we believe, are the most important hyperons, namely, Σ^-, Λ, Δ^-, to the composition and energy. The baryon–baryon interaction energies are assumed to be essentially the same as those between nucleons, except that (1) the interaction energy is different between like baryons ($\Lambda\Lambda$ or pp) and unlike baryons ($\Lambda\Sigma^-$ or np); and (2) there is a special factor of $\frac{3}{2}$ in the strengths of the long-range attractive part of the hyperon–nucleon interaction, as compared to the nucleon–nucleon interaction. The latter is argued on the basis of a quark model. On the other hand, the short-range repulsive part of the interaction is assumed to be the same between all baryon pairs. Four different models are used. One of the main conclusions is that, in the most realistic of the four models used here, there are relatively few protons and hyperons present (no more than 15% of each species even at the highest density considered) and the energy is only slightly less than for a pure neutron gas (20% and 10%, respectively, for the Sawada–Wong and Campi–Sprung interactions). Finally, we calculate the magnetic susceptibility of NSM treated as a pure neutron gas with Sawada–Wong interaction energies. No evidence of a transition to ferromagnetism is found. (auth)

22050 PLANETARY NEBULA NGC 1360 AND ITS NUCLEUS. Doroshenko, V. T. (Astronomical Inst., Moscow). Sov. Astron. AJ (Engl. Transl.); 17: No. 3, 320-324(1973).

Translated from Astron. Zh.; 50: No. 3, 501-507(1973).

Interferometric, spectrographic, and photometric observations of the planetary nebula NGC 1360 and its central star were carried out in the Crimea during January–February, 1972. The heliocentric radial velocity of the nebula is +36.4 ± 1.4 km/sec; its expansion velocity lies in the range 20 to 30 km/sec. The distance of the nebula is $\approx$330 pc and its electron density $n_e \approx 70$ cm^{-3}. The energy flux from the nebulae in the Hα, [OIII] + Hβ, and λ 4686 He II lines was measured. The absolute energy distribution in the continuum of the nucleus and its U, B, V magnitudes were determined; its temperature is $\approx$63,000°K. (auth)

22051 ESCAPE OF STARS FROM OPEN STAR CLUSTERS. II. Danilov, V. M. (Ural State Univ., Sverdlovsk, USSR). Sov. Astron. AJ (Engl. Transl.); 17: No. 3, 346-349(1973).

Translated from Astron. Zh.; 50: No. 3, 541-548(1973).

Approximate expressions are obtained in analytic form for the distribution of the absolute values of stellar velocities in open clusters whose members are not of uniform mass. These functions can be used to calculate the escape rate of the stars. The solutions obtained are applied to a study of the dispersal process for main-sequence and giant stars in the old open cluster NGC 6819. The total escape rate of stars from this cluster is 1.71 per 10^8 yr, corresponding to complete dispersal of the cluster in $4.6 \cdot 10^8$ yr. Effects from mutual encounters of cluster members and galactic-field stars upon the escape rate are taken into account. (auth)

22052 STABILITY OF GRAVITATING SYSTEMS AGAINST SURFACE PERTURBATIONS. Shukhman, I. G. Sov. Astron. AJ (Engl. Transl.); 17: No. 3, 415-416(1973).

Translated from Astron. Zh.; 50: No. 3, 651-653(1973).

A proof is given of the stability of a homogeneous, spherically symmetric system of gravitating masses against surface perturbations that do not change the density of the system. (auth)

22053 MODEL FOR GLOBULAR CLUSTERS WHOSE STARS HAVE A CONTINUOUS MASS DISTRIBUTION. Bagin, V. M. Sov. Astron. AJ (Engl. Transl.); 17: No. 3, 417-419(1973).

Translated from Astron. Zh.; 50: No. 3, 653-657(1973).

A globular-cluster model with a continuous mass distribution for the member stars is analyzed. An explicit equation is obtained for the stellar number-density distribution with respect to mass and radius in the cluster. The total mass density is found to follow a Schuster distribution, and at the cluster periphery stars are successively displaced by less massive stars in qualitative accord with the observations. (auth)

Quasi-Stellar, Radio, and X-Ray Sources

Refer also to abstract 22034.

22054 (CONF-730804-P5, pp 3039-3043) X-RAY OBSERVATION OF THE NORMA-LUPUS REGION. Luyendyk, A. P. J. (Tasmania Univ., Sandy Beach); Fenton, K. B.; Fenton, A. G.; Broderick, A. J. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 5.

An unguided spin stabilized Skylark rocket (SL728) carrying an x-ray astronomy experiment was launched from Woomera at 0907.50 UT on April 16, 1970. The combination of the small coning angle (2.6 degrees) and the high spin rate (3.2 rps) gave a high scan density over the Norma-Lupus region. Information indicating further variability of sources in this region is presented. (auth)

22055 (CONF-730804-P5, pp 3044-3048) HARD X-RAY OBSERVATIONS OF THE REGION FROM THE GALACTIC CENTER TO CENTAURIUS. Guo, D. D. (Univ. of New Hampshire, Durham); Webber, W. R.; Damle, S. V. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 5.

During an 8 hour balloon flight from Parana, Argentina, on November 22, 1971, with a large area (450 cm^2) NaI(Tl) scintillation telescope sensitive to photons within the energy range of 30 keV to 1.5 MeV, the galactic plane and its neighborhood between $l^{II} = 285°$ and $l^{II} = 25°$ including the galactic center were surveyed. Six or more sources were observed. They include GX 304-1, Nor X-2, GX 340+0, and GX 354-5, the nova-like 2U1543-47, and a complex of sources near the galactic center. Spectral characteristics of these sources between 36-174 keV and their comparison with published results from other measurements, and the probable flux limit of line emission near 0.5 MeV from different areas on or off the galactic plane are discussed. (auth)

22056 (CONF-730804-P5, pp 3049-3054) X-RAY SPECTRUM FROM A THIN HOT PLASMA. Nishimura, J. (Tokyo Univ.). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 5.

An analytical solution is derived for the spectrum of photons from a hot plasma, using the Fokker–Planck approximation to the effect of the Compton process and neglecting the effect of stimulated emission. The detailed features of the shape of the x-ray spectrum with changing the size and temperature of plasma are shown after numerical evaluations of this solution. (auth)

22057 (CONF-730804-P5, pp 3501-3512) X-RAYS AND GAMMA RAYS. Pinkau, K. (Max-Planck-Institut fuer Physik und Astrophysik, Munich). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 5.

56 papers were presented at this conference concerned with x- and gamma-ray astronomy. They cover 10^{10} eV in energy scale. X-rays are dealt with briefly since they were covered in the invited lecture by Gursky. Three topics of gamma ray astronomy are covered: gamma ray bursts, the diffuse gamma rays, and the galactic plane emission in gamma rays. (MHR)

22058 PHOTOELECTRIC OBSERVATIONS OF HD 77581. Vidal, N. V. Publ. Astron. Soc. Pac.; 86: No. 511, 317-320 (Jun 1974).

The light curve of HD 77581 (3U0900-40) in V is presented. (auth)

22059 ACCELERATION, RADIATION, AND PAIR PRODUCTION ABOUT ALIGNED MAGNETIC ROTATORS. Hinata, S. (Univ. of Illinois, Urbana). Astrophys. J.; 186: No. 3, 1027-1042(15 Dec 1973).

Some of the processes underlying the theory of pair production and subsequent radio wave emission about a pulsar, as set forth by Sturrock, are clarified. The behavior of charges in a self-consistent electric field in the presence of the poloidal current about an aligned magnetic rotator is investigated. The energy of a charge is obtained as a function of distance along the trajectory, with radiation reaction taken into consideration. It is shown from this that the curvature radiation loss dominates the kinetic energy loss in the vicinity of the star, if the radiation reaction limits the energy of the charge within approximately 1 stellar radius. The luminosity is then obtained as $L^* = (1/64)B_0^2\Omega R^3(\Omega R/c)\sin^6\theta_p$ (where θ_p defines the edge of the polar cap) regardless where the radiation reaction limits the energy of the charge. The braking index for an aligned rotator is obtained as $n = 2.2$ for a particular value $\sin\theta_p = (\Omega R/c)^{1/2}$ which is obtained in another paper The surface magnetic field strength is also estimated as $B_0 \simeq 10^{10}-10^{12}$ gauss from the observation of luminosity. The spectrum of the curvature radiation and the assumed magnetic-field configuration enable one to estimate how many pairs are produced per second, where they are produced, and also the criterion for pair production to take place, $B_{11}T^{-23/35}R_6^{9/35} \gtrsim 0.45$. It is found from this that pair production is likely to take place for most pulsars as Sturrock predicted. (auth)

22060 PROPORTIONAL COUNTER OBSERVATIONS OF DISCRETE GALACTIC X-RAY SOURCES. Brisken, A. F. College Park, MD; Univ. of Maryland (1973). 200p. University Microfilms Order No. 74-9784.

Thesis (Ph. D.).

A sounding rocket experiment launched from White Sands Missile Range on May 19, 1972 carried two multilayer multi-anode xenon filled proportional counters and observed the supernova remnants Cas A and Tycho. No evidence for a stable 2 to 10 keV periodic emission from Cas A or Tycho in the period range of .001 to 10.0 seconds was found. Upper limits to the pulsed fraction are presented as a function of the assumed light curve, with absolute 99% confidence upper limits of 0.089 and 0.195 for Cas A and Tycho, respectively. (WDM)

22061 MODEL FOR THE BINARY X-RAY SOURCE 2U1700-37. Pacheco, J. A. deF. (Sao Paulo Univ., Brazil). Nature (London); 249: No. 5458, 637-638(14 Jun 1974).

It is suggested that in the system 2U1700-37 the primary star, which is an 07f type star (HD153919), is not filling its Roche lobe and that the matter accreted by the neutron star is due to a strong stellar wind from the primary star. The primary star has enough uv radiation to ionize the stellar wind well beyond the neutron star orbit and therefore the accreted material consists mainly of protons and electrons. (UK)

22062 RADIO SPECTRA OF OH471 AND OQ172. Gearhart, M. R. (Ohio State Univ., Columbus); Kraus, J. D.; Andrew, B. H. Nature (London); 249: No. 5459, 743-746(21 Jun 1974).

Radio spectra for the highly redshifted ($z > 3.40$) quasars OH 471 and OQ 172 are collected and presented for frequencies of 16.7 MHz to 85.3 GHz. The spectra are complex; both show peaks at or near 1.4 GHz and near or above 85 GHz, with a low frequency cut-off, that for OH 471 being very sharp. Flux density measurements are also given. Some of the measurements on OH 471 are suggestive of variability. (UK)

22063 NEW POSITION OF CEN X-3 FROM COPERNICUS. Parkinson, J. H.; Mason, K. O.; Sanford, P. W. (University Coll., London). Nature (London); 249: No. 5459, 746-747(21 Jun 1974).

The x-ray source Cen X-3 is known to be part of a pulsating, eclipsing binary system. The source has not yet been positively identified with an optical counterpart, although several candidates have been suggested and are here discussed. Details are given of observations made on the Copernicus satellite in February 1973 with a view to refining the position of the source, and to observe eclipse transitions at lower energies. The instrumentation comprised three co-aligned x-ray detection systems. The observations confirmed an earlier prediction of an extended absorbing atmosphere around the star, clearly showing that the 1.4 to 4.2 keV signal appeared more than an hour after the 4 to 12 keV signal; there was also very little emission at 0.7 to 2.0 keV. Details are given of the refined position. (UK)

22064 INTERPRETATION OF DOUBLE STRUCTURE IN THE CELESTIAL γ-RAY BURSTS. Jelley, J. V. (Atomic Energy Research Establishment, Harwell, Eng.). Nature (London); 249: No. 5459, 747-748(21 Jun 1974).

It is stated that the essentially isotropic distribution of the γ-ray bursts observed by the Vela satellite implies that the sources are either very local and galactic, or very remote and extragalactic. On the theories for a remote origin there are two schools of thought, either that the γ-rays originate in shock waves during the formation of Type II supernovae or that they represent transient pulses of blackbody emission associated with the collapse of a white dwarf to a neutron star. A problem common to both these theories is that they do not readily account for the fact that most of the observed bursts were double, with the second pulse frequently comparable in magnitude to the first. It is here suggested that the sources of the bursts may be identified with the collapse of a rotating magnetized star. At later stages in the collapse axial jets are formed. This suggestion, if acceptable theoretically, could readily account for the double pulses. The pulses will be double since radiation will be observable from both polar jets. A crucial question is whether the jets can penetrate the residual stellar envelope. In conclusion it is stated that any kind of outward-propagating shock wave in a star that is significantly rotationally flattened can give rise to two hot spots on the surface and therefore a double burst. (UK)

22065 SELF-CONSISTENT PULSAR MAGNETOSPHERES IN GENERAL RELATIVITY. Cohen, J. M. (Univ. of Pennsylvania, Philadelphia); Rosenblum, A. Astrophys. J.; 186: No. 1, 267-273(15 Nov 1973).

Pulsars are presently believed to be rotating neutron stars with frozen-in magnetic fields. General-relativistic effects influence not only the structure and stability of neutron stars but also the inertial frames in the vicinity of these rotating dense stars. Furthermore, the pulsar magnetosphere's structure is altered by general-relativistic effects. Here a self-consistent fully relativistic model of the closed field lines in a pulsar magnetosphere is given. This self-consistent model takes account of the dragging of inertial frames as well as the more well-known general-relativistic effects and is a generalization of a previous special-relativistic analysis. (auth)

22066 STATISTICAL STUDY OF THE RADIAL VELOCITIES ASSOCIATED WITH H_α AND [N II] LINES OF TWO H II REGIONS. Louise, R. (Observatoire de Marseille). Compt. Rend., Ser. A; 278: No. 5, 177-179(28 Jan 1974). (In French).

H_α and [NII] interference pattern rings obtained from the nebulae, IC1318 and IC405, were used to establish the radial velocities associated with emission from these two sources. The examination of more than 200 points in these nebulae established that both line emissions are associated with identical turbulent motions. This fact justifies a posteriori the use of this method to determine temperatures in the HII regions from the H_α and [NII] profiles. (FR)

22067 HZ HER, AN ENIGMATIC VARIABLE STAR. Oberstatter, A. Astronomie; 88: 99-102(Mar 1974). (In French).

The characteristics of the variable star HZ Her (which is the same object as the Her X-1 source) are reviewed. Hypotheses are put forward on the nature of this star. (FR)

Solar Phenomena

22068 (CONF-730804-P5, pp 3151-3155) APRIL 17/18, 1972 SOLAR EVENT: SPECTRAL AND DIRECTIONAL MEASURE-

MENTS OF PROTONS, ALPHA-PARTICLES, AND ELECTRONS. Wenzel, K. P.; Domingo, V.; Page, D. E.; Taylor, B. G. (European Space Research and Technology Center, Noordwijk, Netherlands). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 5.

The experiment on the highly eccentric polar orbiting ESRO satellite HEOS-2 yields, in selected angular sectors, four point energy spectra of protons (9 to 36 MeV), of alpha particles (37 to 142 MeV) and of electrons (0.5 to ~3.5 MeV). The fluxes and energy spectra of solar particles observed during the April 17/18, 1972 solar event are reported. Electrons were seen first around 22.00 U.T. on April 17 when HEOS-2 was inbound at 22 earth radii. Protons arrived around 23.00 U.T. Particle fluxes were decaying on April 18, when shortly after the outbound magnetopause crossing at 19.15 U.T. a second particle flux increase was observed. This increase was seen on all electron channels and on the three lower proton channels (reaching 20 p/cm^2 sec sr MeV between 9 and 12 MeV), but not between 28 and 36 MeV. Implications of the observations for solar particle propagation in interplanetary space are discussed. (auth)

22069 (CONF-730804-P5, pp 3375-3398) SOLAR-WIND COMPOSITION AND IMPLICATIONS ABOUT THE HISTORY OF THE SOLAR SYSTEM. Geiss, J. (Univ. of Bern). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 5.

The following topics are discussed: abundances in the solar wind, evidence on solar wind abundances derived from gases trapped in lunar surface material, ^{3}He and tritium in solar wind and solar flares, and historical record of solar wind at lunar surface. (MHR)

22070 (CONF-730804-P5, pp 3685-3705) SOLAR ENERGETIC PARTICLE COMPOSITION. Hovestadt, D. (Max-Planck-Institut fuer Physik und Astrophysik, Munich). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 5.

The main topics discussed are: elemental abundance in flares, particles related to nuclear interactions (isotopes, gamma rays, neutrons, positrons), and "quiet time" interplanetary particles at very low energies. (MHR)

22071 (CONF-730804-P5, pp 3731-3750) PARTICLE PROPAGATION IN INTERPLANETARY SPACE THEORY. Quenby, J. J. (Imperial College, London). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 5.

The transport of 100 keV to 300 GeV energetic particles in the solar cavity, bounded by the chromosphere at the inner edge and the interstellar medium at 30 to 100 AU distance from the sun is discussed. (MHR)

22072 (N-73-33776) STRUCTURAL AND SPECTRAL STUDIES OF SUNSPOTS. Annual Report, 1 September 1972–1 September 1973. Wyller, A. A. (Bartol Research Foundation, Swarthmore, Pa. (USA)). 3 Oct 1973. 57p. (NASA-CR-135787). NTIS $5.00.

The work is reported in the multicolor photometry of umbral cores, and the residual intensity midway between the Na D1 and D2 lines. The photoelectric magnetometer observations, the generation of umbral flashes and penumbral running waves, and the work on sunspot interior modes with Alfen wave emission are discussed. (STAR)

22073 (N-73-33781) SOLAR FLARE EMISSIONS AND GEOPHYSICAL DISTURBANCES. Sakurai, K. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). Sep 1973. 109p. (NASA-TM-X-70479). NTIS $7.50.

Various geophysical phenomena are produced by both wave and particle emissions from solar flares. Using the observed data for these emissions, a review is given on the nature of solar flares and their development. Geophysical phenomena are discussed by referring to the results for solar flare phenomena. (auth) (STAR)

22074 (N-74-15472) THERMALLY DRIVEN MASS FLOWS IN THE CONVECTION ZONE OF THE SUN. Dijkhuis, G. C. (Stanford Univ., Calif. (USA). Inst. for Space Research). May 1973. 118p. (NASA-CR-136505; SU-IPR-518). NTIS $8.00.

A formulation of the fluid dynamics of convective regions is developed which leads to an analytical description of the solar rotation, the Evershed flow, and the supergranulation. The starting point of the present formulation is the mixing length picture of convective equilibrium, but the earlier point mass model for convective molecules is replaced here by a model with both inertia and intrinsic moment of inertia. This extension introduces three rotational degrees of freedom into the dynamics of individual convective molecules, which enter into the dynamical equations for a mixing length fluid in the form of a separate vector field which is termed the spin field. It is shown that for convective molecules having a spherically symmetric mass distribution, the spin field is proportional to the local vorticity. (auth) (STAR)

22075 (N-74-15522) SPACE SHUTTLE PAYLOAD PLANNING WORKING GROUPS. Volume 5. Solar Physics. Final Report. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). May 1973. 101p. (NASA-TM-X-69405). NTIS $7.25.

The findings of the Solar Physics working group of the space shuttle payload planning activity are presented. The areas to be investigated by the solar physics experiments are: (1) the production of mechanical energy in the subphotospheric layers and its transport and dissipation in the upper layers of the atmosphere, (2) the mass flux from the subphotospheric layers into the chromosphere and corona and beyond the solar wind, (3) solar activity and its relationship to magnetic fields, and (4) the production of solar flares. The approach to be followed in conducting the experiments and the equipment required are defined. (auth) (STAR)

22076 CENTER-TO-LIMB CHANGE OF THE FAINT FRAUNHOFER LINE PROFILES. II. Asymmetry and Width of the Lines. Gurtovenko, E. A. Astrometriya Astrofiz.; No. 16, 77-92(1972). (In Russian)

The profiles of fifty very faint Fraunhofer lines were studied and the accuracy of the observations and data processing were analyzed. Asymmetry of the lines was highly diversive. The predominance of the asymmetry with the sloped red wing appeared to be the only regularity. This effect almost disappeared near the limb. Turbulent velocities V_t as deduced from the lines of various elements differed essentially. But the lines of all the elements showed an increase in their width toward the limb. This effect was less for the wide lines. The anomalously large width for most lines may be explained only by the hyperfine and isotopic structure (HFS). The FeI and TiI lines were the narrowest, they seemed to be uninfluenced by HFS. For the supposed model of the anisotropic depth-independent velocity field the FeI and TiI lines gave the following V_t = components: V_t^{rad} = 2.0 km/sec, V_t^{tang} = 2.9 km/sec. (auth)

22077 ROLE OF ELECTRONIC IMPACT IN EXCITATION OF PROMINENCE LUMINESCENCE IN Ca^+ LINES. Polupan, P. N. Astrometriya Astrofiz.; No. 16, 68-77(1972). (In Russian).

The mechanism of electronic impact is of secondary significance in the prominence luminescence excitation in Ca^+ lines as compared with the resonance scattering of photospheric radiation. Its contribution changes considerably with the 1000° temperature change in the prominences. Under conditions of the prominence average temperature the electronic processes provide 4 to 7% of radiated energy in the K and H lines, and combined action of the electronic impact and photospheric radiation through the metastable level 3d adds still 33 to 61% energy to the H and K lines. Similar phenomenon is observed in the ir triplet as well. (auth)

22078 EMPIRICAL DETERMINATION OF THE SOURCE FUNCTION. Gurtovenko, E. A.; Fedorchenko, G. L. Astrometriya Astrofiz.; No. 16, 61-68(1972). (In Russian).

A method of empirical determination of the source function for the upper photosphere based on the center-to-limb observations of central line intensities and the known gf-values for the multiplet lines is developed. The principle of the method does not use any LTE conditions. The method is tested using the observational data by de Jager and Neven. At the same optical depth the derived source function appears to be less than the Planck function. (auth)

22079 CARBON, NITROGEN, AND OXYGEN ABUNDANCES IN THE SUN AND ARCTURUS AND THE CARBON TWELVE/CARBON THIRTEEN RATIO IN ARCTURUS. Upson, W. L. II. College Park, MD; Univ. of Maryland (1973). 118p. University Microfilms Order No. 74-11,670.

Thesis (Ph. D.).

The carbon, nitrogen, and oxygen (CNO) abundances in the Sun were determined by fitting synthetic spectral line profiles generated using the Harvard–Smithsonian Reference Atmosphere (Gingerich, et al., 1971) to the observations of the CNO lines in the infrared made by De Jager and Neven (1967). This yielded the solar abundances (on a logarithmic scale with H = 12.00) of: C = 8.38, N = 8.00, and O = 8.60 of which the N abundance was the most uncertain. The solar CNO abundances were then

used to normalize the molecular band strengths of NH, OH, CH, CN, and C_2 by direct comparison of synthetic spectra with observations. Throughout the work, molecular equilibrium calculations were used to account for the depletion of CNO by molecular formation. The CNO abundances in Arcturus (K2IIIp) were determined by detailed comparison of observed spectra and synthetic spectra using the molecular bands normalized in the Sun and the forbidden [OI] lines. In giant stars, there is a strong gravity effect in the formation of molecular species. A very important consequence of this is that the strength of the [OI] lines and the ratio of the OH to [OI] line strengths is strongly gravity dependent. This allowed the use of forbidden [OI] lines in comparison with OH line strengths to determine the gravity of Arcturus. The $^{12}C/^{13}C$ ratio in Arcturus was determined using the CN red bands. A few features due to ^{13}CN can be identified in the blue CN regions, but, although they agree with the red CN determination, they cannot be used for a good determination of the $^{12}C/^{13}C$ ratio because of severe blending. The following conclusions were drawn: 1. The gravity of Arcturus is about 50 (cgs). 2. The CNO abundances in Arcturus are 7.85, 7.50 and 8.35 respectively. 3. The $^{12}C/^{13}C$ ratio in Arcturus is very close to 7. (Diss. Abstr. Int., B)

22080 SEMI-ANNUAL VARIATIONS IN MAGNETIC ACTIVITY AND SOLAR WIND SPEED. Mayaud, P. N. (Univ., Paris). Compt. Rend., Ser. B; 278: No. 4, 139-142(21 Jan 1974). (In French).

Quantitative results on magnetic activities obtained over a period of 100 years are used to confirm a correlation between the phase of semi-annual variations in magnetic activity and solar-wind speed. This correlation is induced by the solar-wind aberration effect. (FR)

22081 GRAVITATIONAL DEFLECTION OF POLARISED RADIATION. Harwit, M.; Lovelace, R. V. E.; Dennison, B.; Jauncey, D. L.; Broderick, J. (Cornell Univ., Ithaca, NY). Nature (London); 249: No. 5454, 230-233(17 May 1974).

An upper limit is determined for the difference in the deflection of beams of orthogonally polarized radiation passing through the Sun's gravitational field. A null result is anticipated by present theories of gravitation but this prediction has never been tested. (auth)

22082 ENIGMA OF SOLAR NEUTRINOS. Omnes, R. (Univ., Paris). Recherche (Paris); 5: No. 41, 15-21(Jan 1974). (In French).

The neutrino flux measured in the first Davis experiments is five times smaller than that predicted by solar models. A brief discussion is presented on models which might explain these results. (FR)

22083 GEOLOGICAL GLACIATIONS, PALEOMAGNETISM, AND THE PROBLEM OF SOLAR NEUTRINOS. Dauvillier, A. (Observatoire du Pic du Midi, Bagneres-de-Bigorre, France). Bull. Soc. Roy. Sci. Liege; 43: No. 1-2, 35-39(1974). (In French).

Geological glaciations and palemagnetic inversions show a cycle of 2×10^5 years, attributed to an oscillation of the Sun induced by thermonuclear pulses of the core. The present deficit in solar neutrinos would indicate a momentary stoppage of these reactions. (tr-auth)

22084 EXTERNAL GEOPHYSICS: SOLAR PHYSICS EXPERIMENTS CONDUCTED FROM THE D-2B SATELLITE. Delaboudiniere, J. P. (CNRS, Verrieres-le-Buisson, France). Rech. Spatial; 13: No. 1, 3-5(Jan 1974). (In French).

The D-2B satellite solar experiment shortly to be undertaken will involve the systematic collecting of data for two different space physics disciplines: solar physics; high atmosphere physics. Information is obtained using two spectrometers which enable monochromatic images of the Sun to be reconstructed for wavelengths lying between 170 and 1,300 A. Far ultraviolet solar spectra allow the physical conditions in the outer layers of the Sun (chromosphere and corona) to be determined from the emission characteristics of ions having conveniently chosen ionization potentials. (FR)

22085 DETERMINATION OF THE MICROTURBULENCE COMPONENT IN THE SOLAR PHOTOSPHERIC VELOCITY FIELD. I. Use of the Fine Analysis Method to Determine Microturbulence Velocity Using the Example of the 6330 A Crl Line. Gerbil'skii, M. G.; Kondrashova, N. N. Astrometriya Astrofiz.; No. 19, 51-57(1973). (In Russian).

22086 ZODIACAL LIGHT INTENSITY STEADY. Burnett, G. B.; Sparrow, J. G.; Ney, E. P. (Minnesota Univ., Minneapolis). Nature (London); 249: No. 5458, 639-640(14 Jun 1974).

It is stated that continued refinement of data on zodiacal light from OSO-5 has confirmed an earlier conclusion by the authors that the absolute value of both the surface brightness and polarization of the zodiacal cloud varied by less than 10% over the 4 yr. period Jan. 1969 to Jan. 1973. These results are in contrast with recently published satellite measurements, which have reported enhancements of up to 50% or 100%. The enhancements were attributed to comet debris. The present authors found no evidence for a cloud composed of an interwoven maze of comet trails. (UK)

22087 DETERMINATION OF THE MICROTURBULENCE COMPONENT OF THE SOLAR PHOTOSPHERIC VELOCITY FIELD. II. Microturbulence Velocity Determined from Multiple Lines by the Method of Fine Analysis. Kondrashova, N. N. Astrometriya Astrofiz.; 19: 57-63(1973). (In Russian).

22088 APPARATURA I METODY OBRABOTKI RADIOASTRONOMICHESKIKH NABLYUDENII. (Apparatus and Methods of Interpreting Radio-Astronomical Observations). Balklavs, A. E. (ed.). Riga; Izdatel'stvo Zinatne (1972). 128p.

Separate abstracts were prepared for 4 of the 12 chapters. (WDM)

For abstracts of individual chapters see: 22089–22092.

22089 MULTIDIMENSIONAL CLASSIFICATION OF SOLAR RADIOBURSTS. Tsimakhovich, N. P. pp 95-103 of Apparatura i Metody Obrabotki Radioastronomicheskikh Nablyudenii. Balklavs, A. E. (ed.). Riga; Izdatel'stvo Zinatne (1972). (In Russian).

The multidimensional classification of radio bursts of the Sun is described, which are given in a table of the coded symbols of the basic characteristics. This classification is convenient for telegraphic transmissions of the charteristics of radio bursts. (auth)

22090 LONGITUDINAL DISTRIBUTION OF CORONAL ACTIVITY. Tsimakhovich, N. P. pp 105-109 of Apparatura i Metody Obrabotki Radioastronomicheskikh Nablyudenii. Balklavs, A. E. (ed.). Riga; Izdatel'stvo Zinatne (1972). (In Russian).

From observations of the green coronal line, the presence of two antipodal longitudinal intervals of increased activity is established. (auth)

22091 DATA OF THE ROUTINE RADIO OBSERVATIONS IN 8 USSR OBSERVATORIES FROM 1964 TO 1968. Tsimakhovich, N. P. pp 111-117 of Apparatura i Metody Obrabotki Radioastronomicheskikh Nablyudenii. Balklavs, A. E. (ed.). Riga; Izdatel'stvo Zinatne (1972). (In Russian).

Data on materials of routine radio observations of the Sun in eight observatories of the USSR in 1964–1968 are presented. (auth)

22092 OBSERVATION OF THE PARTIAL SOLAR ECLIPSE OF SEPTEMBER 22, 1968, ON THE 75-CM WAVELENGTH. Kamenskii, M. G.; Tsimakhovich, N. P. pp 119-126 of Apparatura i Metody Obrabotki Radioastonomicheskikh Nablyudenii. Balklavs, A. E. (ed.). Riga; Izdatel'stvo Zinatne (1972). (In Russian).

Results of radio observations of the partial solar eclipse on September 22, 1968, on the wavelength of 75 cm are discussed, and the results are compared with previous eclipses. (auth)

22093 CHANGES IN CENTER-TO-LIMB PROFILES OF THE WEAK FRAUNHOFER LINES. III. Profile Shape and Velocity Field. Gurtovenko, E. A. Astrometriya Astrofiz.; No. 19, 35-44 (1973). (In Russian).

A simple, semimorphological analysis is presented for the shape of weak line profiles. The analysis is based on three assumptions: (1) the motion character at an effective optical depth corresponds to a small segment of the weak line profile at or near the line center within wavelength distance; (2) the integral velocity field is represented by a normal distribution; and (3) statistical asymmetry effects are negligibly small and need not be allowed for. Under these assumptions, the line profiles are represented by a Voigt function, and the damping parameter value obtained on this basis is ten times greater than the theoretically computed one. It is suggested that a significant velocity increase in the deeper layers causes the broadening of line wings and produces the spurious effect of excessively high damping constant values. (IAA)

22094 EFFECTS OF TRAVELING SOUND WAVES UPON THE PROFILES OF SPECTRAL LINES. III. Weak Fraunhofer Line Shift. Kostyk, R. I. Astrometriya Astrofiz.; No. 19, 44-51(1973). (In Russian).

A determination of shifts of weak Fraunhofer lines under the action of plane, monochromatic, traveling waves in a homogeneous medium is presented. Calculations indicate that the lines of neu-

tral atoms of low (0 to 2 eV) excitation potential are redshifted, those of a high (4 to 7 eV) potential are violetshifted, and those of a moderate (3 eV) potential are violet- and redshifted. The calculation results are in good agreement with experimental observations. (IAA)

22095 DETERMINATION OF THE NUMBER OF ATOMS IN ERUPTIVE PROMINENCES. Rudnikova, R. G. Astrometriya Astrofiz.; No. 19, 63-70(1973). (In Russian).

Curves of growth and curves of alpha-hydrogen line halfwidths are presented for prominences that consist of fragments having different line-of-sight velocities. The shape of the halfwidth curves shows strong dependence on the motion character. It is shown how the curves of growth and the curves of alpha-hydrogen line halfwidths can be used, in conjunction with observed equivalent width values of the Balmer lines in the spectrum of eruptive prominences, for determining the motion character within the prominences and the number of second-quantum-level hydrogen atoms along the line of sight. (IAA)

22096 SUNSPOT ACTIVITY AND INTERSTELLAR MATERIAL. Mahn, A. (Univ., Frankfurt am Main). Sterne Weltraum; 13: 44-46(Feb 1974). (In German).

The motion of the Sun through space and the interstellar material of the space are considered, giving attention to the effect of this material on astronomical observations. Possible effects of the interstellar material on solar activity are explored, taking into account differences in sunspot observations which depend on the relative position of the Earth to the Sun. It is found that the studies conducted so far do not provide sufficient proof for an effect of the interstellar material on the formation of sunspots. (IAA)

22097 SEARCH FOR NEUTRINOS FROM THE SUN. Heckmann, P. H. (Ruhr Univ., Bochum, Ger.). Sterne Weltraum; 12: 357-361(Dec 1973). (In German).

The solar model in its current status is reviewed and is applied to the calculation of the emission of solar neutrinos. An experiment aimed at recording solar neutrinos, being conducted by Davis and coworkers at a depth of 1480 m in a former gold mine in South Dakota is described, and an appreciable discrepancy between the theoretical and experimental results is noted. Attempts which have been made to interpret this discrepancy are examined, showing that none of these interpretations can be accepted as fully satisfactory. (IAA)

22098 AVERAGE PROPERTIES OF THE SOLAR WIND IN QUIET AND DISTURBED CONDITIONS. Formisano, V.; Moreno, G. (CNR, Frascati, Italy). Lett. Nuovo Cim.; 10: No. 7, 270-274(15 Jun 1974).

The present analysis is based on 2522 hourly averages of the solar-wind parameters, observed by HEOS-1 in the period Dec. 11, 1968–Dec. 29, 1969. Out of these 2522 averages, 597 had $V_p < 350$ km/s (quiet conditions) and 680 had $V_p > 450$ km/s (disturbed conditions). (WDM)

22099 TEMPERATURE DERENDENCE OF LINE RATIOS OF HELIUM-LIKE IONS. Gabriel, A. H.; Jordan, C. (Culham Lab., Abingdon, Eng.). Astrophys. J.; 186: No. 1, 327-333(15 Nov 1973).

In a recent paper Blumenthal et al. suggested that the use of helium-like intercombination to forbidden line ratios to measure electron densities is complicated by an important electron-temperature dependence of the ratios. It is shown here that their theory uses an incorrect treatment of dielectronic recombination and that the temperature dependence is in fact smaller. It is concluded that significant observations of ratios which vary by more than ±10 percent can safely be attributed to electron density effects. Recent observations, in particular those of Acton et al. of O VII, show variations of only ±5 percent. Although Acton et al. consider that their data support the temperature dependence predicted by Blumenthal et al., they can equally well agree with a much lower temperature dependence. However, the accuracy of the observations to date is not sufficient to show a definite dependence on temperature. (auth)

22100 ASYMPTOTIC SOLUTIONS FOR AN INVISCID HEAT-CONDUCTING TWO-FLUID SOLAR-WIND MODEL. Lucas, R. D. (National Center for Atmospheric Research, Boulder, CO). Astrophys. J.; 186: No. 1, 275-284(15 Nov 1973).

The two-fluid solar-wind model of Sturrock and Hartle, which includes the separate electron and proton thermal conductivities and electron–proton energy exchange, is solved asymptotically for large heliocentric distance r. Nine different solutions are found which behave as $T_e \sim T_{e0}r^{-m}$ and $T_p \sim T_{p0}r^{-n}$, where T_e and T_p are the electron and proton temperatures. With the help of matched asymptotic expansions to describe certain singularities that arise at $r = \infty$, three of these solutions—viz., $(m,n) = (2/7,6/7)$, $(2/5,4/5)$, and $(4/3,4/3)$—are shown to pass into the asymptotic solutions of the one-fluid model of Parker and Chamberlain via the limits of either large or small thermal coupling between the two components. The small-coupling limit is used to explain the asymptotic behavior of previously obtained numerical solutions which employed Coulomb interaction processes. The large-coupling limit is specifically emphasized. It is shown how the two-order-of-magnitude increase in the electron–proton energy exchange rate produced by the operation of a certain plasma instability described by Perkins allows a simple model to be derived which predicts at 1 AU $T_e \approx 2 \times 10^5$°K, $T_p \approx 1 \times 10^5$°K, and a solar-wind speed of 340 km s^{-1}. The good agreement of these values with observational data indicates the importance of including realistic non-Coulomb transport processes in the two-fluid solar-wind model. (auth)

22101 HEATING OF SOLAR ACTIVE REGIONS BY MAGNETIC ENERGY DISSIPATION: THE STEADY-STATE CASE. Tucker, W. H. Astrophys. J.; 186: No. 1, 285-289(15 Nov 1973).

It is suggested that solar active regions are heated by the relaxation of stressed magnetic-field configurations. In the present paper the active region is assumed to be in a steady state where the rate of twisting of the magnetic fields is balanced by the rate of dissipation, which in turn is balanced by energy losses due to conduction. In order for the model to be self-consistent the dissipation must occur in small volumes where the current density is large and the plasma is in a turbulent state, i.e., in current sheets. This could explain why high-resolution x-ray observations of active regions show structure which is closely correlated with the photospheric magnetic field. (auth)

22102 IMPULSIVE SOLAR X-RAY BURSTS: BREMSSTRAHLUNG RADIATION FROM A BEAM OF ELECTRONS IN THE SOLAR CHROMOSPHERE AND THE TOTAL ENERGY OF SOLAR FLARES. Petrosian, V. (Stanford Univ., CA). Astrophys. J.; 186: No. 1, 291-304(15 Nov 1973).

Analysis of various aspects of impulsive x-ray bursts (IXBs) has led to a model in which the x rays are produced by bremsstrahlung radiation from a beam of electrons directed toward the photosphere. It is found that in general the x-ray spectrum from such a beam will fall off more rapidly than when the effect of the beaming of radiation is neglected. Furthermore, the spectral index of the resulting x rays appears to increase by about unity for x-ray energies greater than 100 keV, a fact which may explain the observed cutoff in the spectrum of the IXBs. It is also shown that in such a model there is sufficient energy in the form of nonthermal electrons to explain the total energy ($\sim 10^{32}$ ergs) of a flare. (auth)

22103 TURBULENCE OF THE MAGNETIC FIELD OF THE SOLAR WIND IN THE ASTEROID BELT. Salimzibarov, R. B. Cosmic Res. (USSR) (Engl. Transl.); 11: No. 5, 720-721(1973).

Translated from Kosm. Issled.; 11: No. 5, 799-801(1973).

The conditions under which the fluxes of the ionized asteroid gas will cause the magnetic field of the solar wind to become turbulent if the magnitude of the energy flux is comparable with the flux of the magnetic energy of the solar wind passing through the asteroid belt are given. The maximum estimate shows that the ionized fluxes of the asteroid gas not in the state cause the magnetic field of the solar wind to become turbulent, and those even more not in the state cause the flux of the gas of the solar wind to become turbulent. (MHR)

Galaxies

Refer also to abstract 22642.

22104 (CONF-730804-P5, pp 3419-3450) INTERSTELLAR AND INTERGALACTIC MATTER AND RADIATION. Burbidge, G. R. (Univ. of California, San Diego, La Jolla). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 5.

A brief summary of recent studies of the interstellar medium is given. Most attention is then devoted to a review of the evidence for the presence of intergalactic matter and radiation in the universe. It is concluded that the only important constituents which may make a sizable contribution to the total mass-energy are intergalactic gas and condensed objects with a very high mass-to-light ratio. If the QSOs are not at cosmological distances, cold atomic hydrogen may still be the most important constituent and may contribute much more mass than do the galaxies. The x-ray observations still do not unambiguously show that very hot gas is

present, though it is very likely on general grounds that some hot gas is present in clusters of galaxies. The question of whether or not large amounts of matter, enough to close the universe, are present, remains unsettled. From the theoretical standpoint the answer depends almost completely on the approach taken to the problem of galaxy formation and to the cosmological model which is favored. (auth)

22105 GALAXIES WITH ULTRAVIOLET CONTINUUM. V. Markaryan, B. E.; Lipovetskii, V. A. (Byurakan Astrophysical Observatory, Moscow). Astrophysics (Engl. Transl.); 8: No. 2, 89-99(1972).

Translated from Astrofizika; 8: No. 2, 155-164(1972).

A fifth list of galaxies with ultraviolet continuum is presented. The list contains observational data on 106 new objects. The method of observation and search for galaxies has been described in the earlier papers of this series. All the notation in the present list is the same as before. Emission lines were detected or suspected for 82 objects. A total of 47 objects were classified as s-sd, and four of them are very probably objects of Seyfert type. Their serial numbers in the list are distinguished by one asterisk. A further seven objects are distinguished by two asterisks and are candidates for QSO's. (auth)

22106 NATURE OF GALAXIES WITH ULTRAVIOLET CONTINUUM. I. Principle Spectral and Color Characteristics. Markaryan, B. E. (Byurakan Astrophysical Observatory, Moscow). Astrophysics (Engl. Transl.); 8: No. 2, 100-105(1972).

Translated from Astrofizika; 8: No. 2, 165-176(1972).

The results of spectral and photoelectric observations of galaxies with ultraviolet excess are considered. Emission lines are observed in the slit spectrograms of almost all galaxies that have a strong ultraviolet continuum. This indicates the presence of a hot gas and a central source of high-frequency radiation in their nuclei. The photoelectric results reveal a similarity between these galaxies and QSO's with regard to the energy distribution in the spectrum, from which a nonthermal origin of their emission follows. The overwhelming majority of galaxies of the type s-sd and a small fraction of galaxies of the type d-ds have condensed, star-like nuclei. A quarter of these objects have Seyfert characteristics. These objects form a special class of galaxies that have nuclei in different stages of activity, including the Seyfert phase. (auth)

22107 SPECTRA OF MARKARYAN GALAXIES. Arakelyan, M. A.; Dibai, E. A.; Esipov, V. F. (Byurakan Astrophysical Observatory, Moscow). Astrophysics (Engl. Transl.); 8: No. 2, 106-111(1972).

Translated from Astrofizika; 8: No. 2, 177-186(1972).

The results are given of spectroscopic observations of 76 objects from the fourth list of galaxies with ultraviolet continuum. Emission lines were discovered in the spectra of 61 objects. The objects No. 304, 335, 348, 352, 372, and 374 exhibit the spectral features of the nuclei of Seyfert galaxies. (auth)

22108 HYDROGEN LINES IN THE SPECTRUM OF THE GALAXY MARKARYAN 6 DURING ITS ACTIVITY. Pronik, V. I.; Chuvaev, K. K. (Crimean Astrophysical Observatory, USSR). Astrophysics (Engl. Transl.); 8: No. 2, 112-116(1972).

Translated from Astrofizika; 8: No. 2, 187-196(1972).

In 1970–71 spectra were obtained of the galaxy Markaryan 6 (IC 450) with dispersions 330 and 100 Å/mm by means of an image-tube spectrograph on the 2.6-meter telescope of the Crimean Astrophysical Observatory. During a year of observations the flux in H_β decreased by a factor of almost 2, and the intensity of the continuous spectrum decreased by more than a factor 3. These two quantities were clearly correlated. At large fluxes in the continuous spectrum, H_β became saturated. In all the spectra the hydrogen lines have very broad wings (~ ±5500 to 6000 km/sec). The complicated structure of these lines indicates the existence of the individual clouds of gas with different velocities. The blue-shifted component of the hydrogen lines discovered in the beginning of 1969 by Khachikyan and Weedman still exists. (auth)

22109 PHOTOMETRY OF THE GLOBULAR CLUSTERS OF NGC 185. Hodge, P. W. (Harvard Coll. Observatory, Cambridge, MA). Publ. Astron. Soc. Pac.; 86: No. 511, 289-293 (Jun 1974).

Photometry in the UBV system for five recognized globular clusters in NGC 185 shows that their colors are normal and the luminosities are low. A brief rediscussion of the use of globular clusters as extragalactic distance indicators is based on the recent photometry of globular clusters in the M31 group. (auth)

22110 DARK NEBULAE IN THE SMALL MAGELLANIC CLOUD. Hodge, P. W. (Harvard Coll. Observatory, Cambridge, MA). Publ. Astron. Soc. Pac.; 86: No. 511, 263-266 (Jun 1974).

A search for dark nebulae on a set of Schmidt telescope plates of the Small Magellanic Cloud resulted in a catalog of 45 objects, ranging from 1′ to 6′ in major dimension. The average size is 42 pc, and the average extinction, a few tenths of a magnitude. They are generally about half the size of those found in a similar survey of the Large Magellanic Cloud. (auth)

22111 SEARCH FOR GALAXIES AT LARGE REDSHIFT. Davis, M. Princeton, NJ; Princeton Univ. (1973). 137p. University Microfilms Order No. 74-9672.

Thesis (Ph. D.).

A diffuse image photometer was constructed that is useful for detecting extended objects (~100 arcsec^2) of low surface brightness. The instrument contains a rotating half-moon aperture that chops the sky, and therefore measures the difference in sky brightness from one side of the aperture to the other. The primary purpose of the instrument is to search for galaxies of large redshift ($Z > 4$) possibly undergoing a bright phase of evolution. Several models of "young galaxies" are reviewed and it is suggested that they may have luminosities hundreds of times that of present day galaxies. They can be expected to have significant angular extent, with surface brightness far below the night sky brightness. The expected redshift of these objects is very uncertain, and can range from 5 to 100, which implies most of the radiation will arrive in the infrared. Using the Mauna Kea 88″ telescope a 1.2×10^4 arcsec area of the sky that is blank on the Palomar Sky Survey red plates was searched. No objects were detected to a flux limit of 25×10^{-29} ergs cm^{-2} sec^{-1} Hz^{-1} in a bandwidth of 6200 to 9000 Å. The null results put useful upper limits on the density and luminosity of bright young galaxies for $Z < 7$. The photometer was also used to search for optical counterparts of blank field radio sources. Of 3 sources examined, one, 4C 34.46, was tentatively identified. Broadband spectra of several 20th magnitude radio sources were measured in an attempt to measure their redshift. (Diss. Abstr. Int., B)

22112 DIAMETER–LUMINOSITY RELATION OF GALAXIES. Balinskaya, I. S.; Karachentsev, I. D. Astrometriya Astrofiz.; No. 16, 112-120(1972). (In Russian).

The regressions M on γ and γ on M were examined for sample distributions of galaxies of absolute magnitude M and log-diameter $\gamma = \lg D_{kps}$. It was found that the following circumstances influence the value of the regression coefficient: (a) the errors of scale of angular diameter, due to the data of various authors, (b) the physical variations in M (γ) relation for various clusters, (c) the dominance of the morphological type of sample members. The relation $M \sim -(4.53 \pm 0.28)\ \gamma$ in Vaucouleur's scale of diameters was obtained. (auth)

22113 SPECTROSCOPIC STUDY OF SOME COMPACT GALAXIES. Carozzi, N.; Chamaraux, P.; Duflot, R. (Observatoire de Haute Provence, Saint-Michel-l'Observatoire, France). Compt. Rend., Ser. B; 278: No. 10, 429-431(4 Mar 1974). (In French).

Fourteen compact blue galaxies were studied. Seven of these galaxies possess an absorption spectra and five of them exhibit line spectra. Within the limits of experimental error, these galaxies are positioned on the Hubble diagram between normal and QSS galaxies. (FR)

22114 SCATTERED-LIGHT PHENOMENA IN INTERSTELLAR SPACE. Mattila, K. (Univ. of Helsinki). Sterne Weltraum; 12: 246-251(Sep 1973). (In German).

The two processes involved in interstellar extinction produced by the interstellar dust include absorption and scattering. The diffusion function describes the angular distribution of the scattered light. This distribution depends on the refractive index, the magnitude, and the form of the particles. The scattered light is polarized. Phenomena connected with the light scattered by the interstellar dust include the reflection nebulae and the galactic scattered light. A particularly interesting group among the reflection nebulae is formed by nebulae whose brightness changes as a consequence of the variability of the star which provides the radiation for the nebula. Dark nebulae represent similar aggregations of dust as reflection nebulas. (IAA)

22115 NONTHERMAL OH EMISSION IN INTERSTELLAR DUST CLOUDS. II. Turner, B. E. (National Radio Astronomy Observatory, Charlottesville, VA). Astrophys. J.; 186: No. 1, 357-395(15 Nov 1973).

Observations of the four 18-cm lines of OH have been made at 20 positions in 11 dark dust clouds. They show that anomalous excitation of the two satellite lines occurs in almost every case, and that anomalies also exist in the main lines in 7 cases. Collisions of H or H_2 with OH are shown to pump the 18-cm Λ-doublet even at the low temperatures encountered in dust clouds. Ultraviolet pumping may also produce these effects in principle, provided suitable sources of ultraviolet radiation exist. The satellite-line anomalies are explained in terms of pumping by infrared

radiation. Such radiation can be released by the primary pumping process for the Λ-doublet, or by other processes (electron or noninverting H_2 collisions) that excite the OH to the $II_{\frac{1}{2}}$, $J = \frac{1}{2}$ levels; it can also be generated by infrared stars within the dust clouds. (auth)

22116 DETECTION OF NEW LARGE ANGULAR EXTENT IONIZED HYDROGEN FORMATIONS IN THE LOCAL ARM AND THE SAGITTARIUS ARM OF THE GALAXY. Sivan, J. P. (CNRS, Marseille). Compt. Rend., Ser. A; 278: No. 4, 127-129(21 Jan 1974). (In French).

Photographs of the 60° field were used to obtain a complete chart of galactic H_α emission. The most spectacular and interesting information is presented: general diffuse emission in the Sagittarius arm; new very extensive HII regions in this arm and the local arm; extension of the Orion complex between the galactic latitudes of 0 and −55°. (FR)

22117 PECULIAR VELOCITIES OF GALAXIES AND INDICATIONS OF THE EXISTENCE OF A LOCAL CLUSTER. Fesenko, B. I. (Pskov Teachers Coll., USSR). Sov. Astron. AJ (Engl. Transl.); 17: No. 3, 314-316(1973).

Translated from Astron. Zh.; 50: No. 3, 491-495(1973).

An angular-diameter method was developed for the purpose of determining the peculiar velocity of the Galaxy and the peculiar-velocity dispersion of external galaxies. For field galaxies whose mean radial velocity exceeds 1000 km/sec, the rms peculiar velocity projected on the line of sight is ≈340 km/sec, and the Galaxy's peculiar-velocity component Z relative to those objects is +290 km/sec. For the closest galaxies beyond the Local Group, these values are considerably smaller. This disparity, as well as the distinctive angular-diameter distribution of bright galaxies, indicates that a dispersed local cluster exists comprising 50 to 100 members, not counting dwarf galaxies. (auth)

22118 TEMPERATURE GRADIENT IN GASEOUS NEBULAE. Pyatunina, T. B.; Soglasnova, V. A. (Central Astronomical Observatory, Pulkovo, USSR). Sov. Astron. AJ (Engl. Transl.); 17: No. 3, 325-329(1973).

Translated from Astron. Zh.; 50: No. 3, 509-515(1973).

A method is proposed for computing the electron temperature in a gaseous nebula averaged along the line of sight and the true temperature as a function of distance from the exciting star using radio isophotes at two different frequencies. From observations at $\lambda_1 = 1.95$ cm and $\lambda_2 = 75$ cm the T_e distribution averaged along the line of sight is computed for two nebulae, Orion A and the Omega. The computed distribution can explain the Orion A radio spectrum without resorting to a very low temperature (≈4000°K). In the Omega, the disparity between the observed and predicted frequency of the bend in the spectrum suggests that unresolved structure exists at 1.95 cm. For the Orion, the same data are used to establish the true T_e distribution with distance from the center of the nebula; it drops from 19,000°K to 4000°K at 3.5′ distance. The weighted average of T_e along the line of sight corresponding to LTE emission in the hydrogen recombination lines is consistent with available observational data. (auth)

22119 RADIO TRANSITIONS OF THE ^{16}OD MOLECULES. Khersonskii, V. K. (Special Astrophysical Observatory, Moscow). Sov. Astron. AJ (Engl. Transl.); 17: No. 3, 411-412(1973).

Translated from Astron. Zh.; 50: No. 3, 646-649(1973).

The frequencies and probabilities of seven permitted transitions between the hyperfine sublevels of the ground state of the $O^{16}D$ molecule are calculated, using experimental data available for other transitions. (auth)

22120 TEMPERATURE-GRADIENT INSTABILITY OF A GRAVITATING MEDIUM. Polyachenko, V. L.; Shukhman, I. G. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Novosibirsk, USSR). Sov. Astron. AJ (Engl. Transl.); 17: No. 3, 413-414(1973).

Translated from Astron. Zh.; 50: No. 3, 649-651(1973).

The growth rates of temperature-gradient instability are calculated for a homogeneous, infinitely long model cylinder with a longitudinal temperature depending on the radius. (auth)

Cosmology

Refer also to abstracts 22081 and 22353.

22121 (N-73-33779) CELESTIAL DIFFUSE GAMMA RADIATION ABOVE 30 MeV OBSERVED BY SAS-2. Fichtel, C. E.; Kniffen, D. A.; Hartman, R. D. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). Sep 1973. 12p. (NASA-TM-X-70485). NTIS $3.00.

The Small Astronomy Satellite (SAS)-2, launched on November 15, 1972, carried into orbit a 32-deck magnetic-core digitized spark chamber gamma-ray telescope to study celestial gamma radiation in the energy range above 30 MeV. In the study of several regions with $b_2 < 15°$, a finite, diffuse flux of gamma rays with a steep energy spectrum in the energy region from 35 to 200 MeV is observed. Representing the energy spectrum by a power law of the form $dJ/dE = AE^{-\alpha}$ over this energy range, alpha is found along with the integral flux above 100 MeV. Combining this result with existing low-energy gamma-ray data yields an energy spectrum which is not a simple power law in energy, as in the x-ray region, but which demonstrates first an increase and then a decrease in slope consistent within uncertainties with that predicted by cosmological theories, including the continuous production of high energy gamma rays primarily from neutral pi mesons throughout the history of the Universe. (auth) (STAR)

22122 DYNAMICS OF GRAVITATING SYSTEMS ON A NEUTRINO BACKGROUND OF THE UNIVERSE. Omarov, T. B. (Astrophysics Inst., Moscow). Astrophysics (Engl. Transl.); 8: No. 2, 189-194(1972).

Translated from Astrofizika; 8: No. 2, 315-323(1972).

A study was made of the gravitational influence of a homogeneous neutrino sea of an expanding universe on the dynamics of a pair of quasipoint bodies against its background. On the basis of a "similar" integrable problem, relations are proposed that describe the general properties and behavior of the system. In particular, for the relative motion of two bodies in an orbit of elliptic type it is shown that if the oscillating period of revolution at the epoch t_0 (one of the moments of passage through the pericenter) is much shorter than the actual time t_0 measured from the singularity (when the density of the background substrate becomes infinite), the influence of the neutrino sea can reduce to a systematic perturbation of only the position of the pericenter. (auth)

22123 ACCRETION PROBLEM IN THE SCHWARZSCHILD GEOMETRY. Hwang, A. E. Austin, TX; Univ. of Texas (1973). 117p. University Microfilms Order No. 74-5258.

Thesis (Ph. D.).

Spherically symmetric gravitational accretion onto a Schwarzschild source was analyzed as a means by which to detect and observe black holes. The accreting matter was treated either as an aggregate of independent, noninteracting particles or as a test hydrodynamic fluid. The equations of relativistic thermohydrodynamics were developed and it was demonstrated that the mass fluxes which result from fluid accretion are considerably more substantial than those which occur for particle infall. The power spectrum of the radiation emitted during accretion was investigated. It is shown that the spectrum of the radiation is modified by the presence of magnetic fields and turbulent disturbances. Apart from reviewing the current status of research in geodesic accretion, nongeodesic gravitational accretion in the Schwarzschild geometry was studied. The existence of compression shock waves in a large class of fluids undergoing nongeodesic accretion was demonstrated. Finally a model is proposed in which these shock waves precipitate the conversion of neutron stars into black holes. (Diss. Abstr. Int., B)

22124 GEOMETRICAL INTERPRETATION OF STEADY-STATE COSMOLOGY. Hafner, H.; Ionescu-Pallas, N. J. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys.; 19: No. 1, 105-106(1974).

In Hoyle's cosmology, one considers a creaction force which brings the theory in agreement with Mach's principle, but which has no geometrical interpretation. Because of that, a certain supplementary quantity must be added to the tensor of matter in order to get the conservative case. A possible geometrical interpretation of Hoyle's theory based on the extension of the notion of Riemannian space is suggested. (WDM)

22125 DUST SPHERE IN AN EMPTY SPACE. Korkina, M. P.; Martinenko, V. G. Ukr. Fiz. Zh. (Ukr. Ed.); 18: 1944-1950(Dec 1973). (In Ukrainian).

A sphere of dust-like matter in an empty space is analyzed, using Friedman's solution in synchronous coordinates for the empty space. By using these coordinates, all the necessary conditions are satisfied, and the external and internal metrics can be seen without preliminary transformation. The conditions for the formation of a semiclosed Universe in the obtained solution are determined, and the formation and branching of a semiclosed Universe is demonstrated by representing the synchronous coordinates as a surface of revolution. The results obtained in synchronous coordinates are compared with those of Newtonian theory. (IAA)

22126 COSMIC ABUNDANCE OF DEUTERIUM AND THE SCALAR FIELD. Occhionero, F. (Laboratorio di Astrofisica Spaziale, Rome). Lett. Nuovo Cim.; 10: No. 7, 281-285(15 Jun 1974).

It has been pointed out that the large abundance of deuterium may be explained easily in terms of spallation reactions occurring efficiently in outgoing shock waves in supernova explosions; the possibility is considered of increasing the deuterium yield of the cosmological big bang by a slight speeding-up of the expansion of the Universe during the thermonuclear combustion phase $n + p \rightleftharpoons d + \gamma$ which occurs around $T_1 = 10^9$ °K; such a speeding-up is obtained by postulating the existence of a scalar field in the sense of the scalar-tensor theory of gravity. (WDM)

22127 SOLVABLE QUANTUM COSMOLOGICAL MODEL AND THE IMPORTANCE OF QUANTIZING IN A SPECIAL CANONICAL FRAME. Kaup, D. J.; Vitello, A. P. (Clarkson College of Tech., Potsdam, NY). Phys. Rev., D; 9: No. 6, 1648-1655(15 Mar 1974).

By analyzing the simple cosmological model consisting of a real massless Klein–Gordon field with vanishing spatial derivatives in the Friedmann universe, it is concluded that this model can be successfully quantized only by using an extrinsic time. If one attempts to quantize using an intrinsic time, one is faced with the problem of either not having a point of maximum expansion, which violates the correspondence principle, or a necessity to devise a new interpretation for a zero-normed quantum mechanics (in addition to the particle–antiparticle interpretation). However, if one uses an extrinsic time, none of these difficulties occur. In analyzing the distinction between these two quantization procedures, it is noted that there are two distinct types of quantum-mechanical tunneling. The first type is the usual quantum-mechanical tunneling called "coordinate-space tunneling," where the topology of the classical phase space is usually planar and the phase space has no classically forbidden regions, although for a fixed energy, there can exist certain regions of coordinate space that are classically forbidden. The second type occurs when the phase space has classically forbidden regions, and tunneling into these regions is called "phase-space tunneling." In terms of these two types of tunneling, quantization with an intrinsic time allows "phase-space tunneling" to occur, and it is the presence of this type of tunneling that gives this solution its undesirable features. On the other hand, quantization with a particular choice of extrinsic time absolutely forbids the occurrence of "phase-space tunneling," and it is the lack of this type of tunneling that gives this model its desirable features. Thus, based on this model and other general arguments, it is proposed that although "coordinate-space tunneling" is quantum-mechanically allowed, the distinctly different tunneling process, "phase-space tunneling," is not only classically forbidden, but also must be considered to be quantum-mechanically forbidden as well. (auth)

Planetary Phenomena

Refer also to abstract 22002.

22128 (AD-772080) ENERGETIC ELECTRONS IN THE MAGNETOSPHERE OF JUPITER. Van Allen, J. A.; Baker, D. N.; Randall, B. A.; Thomsen, M. F.; Sentman, D. C. (Iowa Univ., Iowa City (USA). Dept. of Physics and Astronomy). 20 Dec 1973. Contract N00014-68-A-0196-0003. 20p. NTIS $3.00.

Preliminary results of in situ observations of energetic electrons in the magnetosphere of Jupiter during the Pioneer 10 encounter 26 November–11 December 1973 are discussed. (GRA)

22129 MODULATION OF THE JOVIAN DECAMETRIC RADIO EMISSION BY IO. Wu, C. S. (Univ. of Maryland, College Park). Astrophys. J.; 186: No. 1, 313-326(15 Nov 1973).

It is argued that the sweeping of trapped energetic MeV protons by Io can result in induced emissions. The instability is caused by the density gradient occurring at the edge of the cavity. It is shown that the azimuthal Larmor drift of the energetic protons which is transverse to both the local magnetic field and the density gradient can excite extraordinary waves with frequencies slightly above the local electron cyclotron frequency. It is found that the emission coefficient is proportional to $(n_p/n_t)^4$, where n_p and n_t denote the density of the energetic protons and the density of the thermal electrons, respectively. The theory also predicts a lower frequency cutoff. This cutoff frequency depends upon the density of thermal electrons in the source region. (auth)

22130 MEASUREMENT OF LOW-ENERGY PARTICLES BY THE AUTOMATIC INTERPLANETARY STATIONS MARS-2 AND MARS-3. I. Apparatus and Measurement Procedure. Ainbund, M. R.; Bogdanov, A. V.; Vaisberg, O. L.; Vasil'ev, E. M.; Zhurina, L. S.; Zertsalov, A. A.; Karpinskii, I. P.; Kovalenko, V. G.; Polenov, B. V.; Subbotin, V. I.; Tel'kovskii, V. G.; Khazanov, B. I. Cosmic Res. (USSR) (Engl. Transl.); 11: No. 5, 661-665(1973).

Translated from Kosm. Issled.; 11: No. 5, 738-742(1973).

A device for measuring electrons and ions over the energy range from 0.03 to 10 keV is described. Two of these instruments were installed on the "Mars-2" and "Mars-3" automatic interplanetary stations. The device is an 8-channel electrostatic analyzer and each channel carries out the measurement in its own energy range. Channel electron multipliers were used as detectors, operating under individual particle counting conditions. The dynamic range of the fluxes measured was 10^5–10^9 particles/cm^2 · sec · sr. (auth)

22131 MEASUREMENT OF LOW-ENERGY PARTICLES ON BOARD THE MARS-2 AND MARS-3 AUTOMATIC INTERPLANETARY STATIONS. II. Preliminary Results. Vaisberg, O. L.; Bogdanov, A. V.; Borodin, N. F.; D'yachkov, A. V.; Zertsalov, A. A.; Karpinskii, I. P.; Kondakov, S. P.; Mamotko, Z. N.; Polenov, B. V.; Romanov, S. A.; Smirnov, V. N.; Khazanov, B. I. Cosmic Res. (USSR) (Engl. Transl.); 11: No. 5, 666-676(1973).

Translated from Kosm. Issled.; 11: No. 5, 743-755(1973).

Data on fluxes of charged particles having energies of 0.03 to 10 keV obtained using the Mars-2 and Mars-3 automatic interplanetary stations are presented. Measurements of the solar wind were made over a long period. A region was discovered at an average distance of ~3000 earth radii where the flux of ions is disturbed by passing around the earth's magnetosphere. The geometry of this region relative to the earth is presented. Anomalies are observed in the energetic spectra near Mars which are explained by the disturbing effects of the planet. An analysis of the energetic spectra of ions showed that a boundary shock wave is formed in the interaction of the solar wind with Mars. Ions having very low energies (~30 eV) are found at a distance of 1000 to 2000 km from the planet, possibly of ionospheric origin. (auth)

22132 MEASUREMENT OF VARIATIONS IN THE INTEGRAL ELECTRON CONCENTRATION ALONG THE LINE OF COMMUNICATION WITH THE MARS-2 STATION BY THE METHOD OF DISPERSION INTERFEROMETRY. Savich, N. A.; Andreyaniv, V. V. Cosmic Res. (USSR) (Engl. Transl.); 11: No. 5, 677-681 (1973).

Translated from Kosm. Issled.; 11: No. 5, 756-760(1973).

Variations in the integral electron concentration ΔN_n of the cosmic plasma were measured by the method of two-frequency dispersion interferometry, the transmitting device of which was mounted on the Mars-2 station. Experimental data for 16 sessions of measurements conducted on the interplanetary section of the station's flight are presented in the form of graphs of the time dependence. In two sessions very large and rapid variations $\Delta N_n \simeq 5.7 \cdot 10^{12}$ cm^{-2} and $14.5 \cdot 10^{12}$ cm^{-2} with rates of change of $\sim -3.7 \cdot 10^9$ cm^{-2} · sec^{-1} and $9.3 \cdot 10^9$ cm^{-2} · sec^{-1} were recorded which are explained by effects of the interplanetary plasma. It is demonstrated that these events could be caused either by impulses of corpuscular fluxes or by the sectorial structure of the solar wind intersected by the line of communication during the measuring sessions. (auth)

22133 INSTRUMENTATION, EXPERIMENTAL PROCEDURE, AND MAIN RESULTS OF THE GAMMA-RADIATION INVESTIGATION OF VENUS SURFACE BY THE VENERA-8 SPACECRAFT. Surkov, Yu. A.; Kirnozov, F. F.; Sobornov, O. P.; Fedoseev, G. A.; Myasnikova, L. N.; Kononov, B. N.; Kurochkin, S. S.; Fertman, D. E. Cosmic Res. (USSR) (Engl. Transl.); 11: No. 5, 699-706 (1973).

Translated from Kosm. Issled.; 11: No. 5, 781-789(1973).

With the help of a scintillation γ-ray spectrometer mounted on the Venera-8 interplanetary spacecraft the radium, thorium, and potassium content in Venusian rock, which amounts to $2.2 \cdot 10^{-4}$, $6.5 \cdot 10^{-4}$, and 4%, respectively, was first determined. A description is given of the experimental procedure and of the results of the γ-ray measurements in the atmosphere and on the surface of Venus. The data obtained from the γ-ray measurements regarding the content and ratio of natural radioactive elements are compared with the data for terrestrial rocks. Ideas as to the nature of Venusian rocks and the mechanism of their formation are discussed. (auth)

PHYSICS (ATMOSPHERIC)

Auroral and Ionospheric Phenomena

22134 CHARACTER OF THE NEGATIVE DISTURBANCE MANIFESTATION IN THE F-REGION OF IONOSPHERE IN THE MID-LATITUDINAL ZONE. Mebagishvili, N. N.; Khocholava, G. M. (Inst. of Geophysics, Tbilisi, USSR). Soobshch. Akad. Nauk Gruz. SSR; 74: No. 1, 77-79(Apr 1974). (In Russian)

The change of the ionization state in the F region of the ionosphere in connection with the development of a geomagnetic storm is shown on the basis of the data of the Leningrad, Moscow, Rostov, and Alma-Ata stations. The empirical formulae were obtained for the delay time (ΔT) of the commencement of a drop in the electron concentration relative to the onset of the geomagnetic storm and for the size of maximum depression relative to the latitude. (auth)

22135 NUMERICAL STUDY OF THREE-DIMENSIONAL DIURNAL VARIATIONS WITHIN THE THERMOSPHERE. Volland, H. (Univ., Bonn); Mayr, H. G. Ann. Geophys.; 29: No. 1, 61-75(Jan 1973).

Numerical calculations of the generation and propagation of the two important fundamental symmetric tidal wave modes—the diurnal mode (1,1,1) and the semi-diurnal mode (2,2,2)—have been performed applying a realistic model thermosphere and taking into account heat conduction and the temporally and spatially varying ion–neutral collision number. Both wave modes are predominantly generated by the solar euv heat input. It is shown that the latitude structure of the (1,1,1) mode which is identical with the Hough function (1,-1) within the lower nondissipative atmosphere degenerates into the spherical function $P_{(1,1)}$ at thermospheric heights. The pressure field of this mode constitutes the observed pressure bulge of the thermosphere, the diurnal component of which peaks at 15 h L.T. in the model of Jacchia and Slowey (1967). Its horizontal wind field agrees with the wind system derived by Kohl and King (1967), and by Geisler (1967). The electric polarization field of the geomagnetic S_q current generates a significant fraction of this wave mode at F-layer heights. This wave component shifts the total horizontal wind system to earlier times by about 1 hour in agreement with ionospheric observations. The latitude structure of the (2,2,2) mode is identical with the Hough function (2,2) within the lower nondissipative atmosphere. It degenerates to the spherical function $P_{(2,2)}$ at thermospheric heights. A component of this wave mode generated below 100 km can penetrate deep into the thermosphere and remains significant even at 400 km. Moreover, an additional wave component is generated due to nonlinear interaction between wave mode (1,1,1) and wave mode (2,2,2) via ion-neutral collisions at F-layer heights. The interference between these two contributions and the xuv-generated wave at thermospheric heights causes a phase delay between density and temperature of about 2 hours in the semi-diurnal component, which contributes to the observed delay between the times of the density and temperature maxima of the neutral gas at thermospheric altitudes as observed by Mahajan (1969), and by Waldteufel and McClure (1969). (FR)

22136 SPECTRA OF IONOSPHERIC PHOTOELECTRONS AND THEIR TRANSPORT FROM CONJUGATE IONOSPHERE. Galperin, Yu. I. (Inst. of Space Research, Moscow); Mulyarchik, T. M.; Serafimov, K. B.; Shuiskaya, F. K.; Dymek, M.; Wernik, A.; Kutiev, I.; Serafimiv, K. B. Ann. Geophys.; 29: No. 1, 117-125 (Jan 1973).

Energy spectra of ionospheric photoelectrons were measured in the range 30 to 150 eV on the Cosmos-348 satellite in summer 1970 with $\Delta E/E = 0.2$. The averaged spectra is of double exponential shape with $E_0 = 10$ in the range 30 to 85 eV and $E_0 = 28$ eV in the range 85 to 150 eV. The energy E at which the change in the slope occurs is relatively stable within experimental error ± ±10 eV. The shape of the measured spectra are within reasonable agreement with existing theoretical computations. For the downward going conjugate photoelectrons measured in the dark end of the field tube the spectrum shape is changed by significant diminution of the lower energy electrons in the measured range. Large amount of scattering of daytime photoelectrons from the loss cone where they originate to higher pitch angles is observed especially again for lower energies. These facts signify to the existence of some unidentified scattering mechanism which favors lower energies. It is supposed that this particular scattering prevents the quasitrapping (or storage) of photoelectrons to appear in this period in contrast to Cosmos-5 observations in 1962 (but at higher altitudes) when the quasitrapping of photoelectrons was definitely observed. Comparisons are made between the spectra of the upward going photoelectrons which have been transported from the conjugate ionosphere along magnetic force tube from the measurements of the heights where the scattering of photoelectrons by atmospheric particles is insignificant. Due to existence of the characteristic change of slope on the photoelectron energy spectrum such comparisons make it possible to measure the electric potential difference between the two ends of the magnetic force tube in the middle lattitude F region. From the measurements of E on 17 June 1970 it is shown that the difference u is less than ±10 volts. Supposing that there are no potential gaps symmetrical to the equatorial plane one may deduce from this the parallel electric field strength E obtained as $E = U/l$ where l is the length of the magnetic field line. (FR)

22137 STORM-TIME VARIATION OF F2 REGION. Kane, R. P. (Physical Research Lab., Ahmedabad, India). Ann. Geophys.; 29: No. 1, 25-42(Jan 1973).

The storm-time variation of foF2 indicates that in individual storms change as large as ±50% can occur usually during peak storm hours but often earlier and/or later. For averages of several storms, there is good correlation with the Main Phase Onset (MPO) (rather than with SSC). For high and middle latitudes, ionospheric D_{st} effects are unambiguous decreases. For low latitudes, the effect is an increase but conspicuous for daytime values only, the night values showing a decrease or an erratic behavior. For severe storms, the increase is 7 to 10% and is preceded by a decrease of about 2 to 3% at or before MPO. For these D_{st} effects, the electromagnetic drifts do not seem to play any significant role. Instead, effects due to neutral winds and/or precipitation from the plasmasphere are possibly indicated; but individual storms show occasionally dissimilar effects even within a few hundred miles indicating considerable influence of local geographic and/or geomagnetic conditions. Conspicuous SD (local time) effects are seen and show enhancements of foF2 associated with a weakening of the electrojet indicating electromagnetic drift effects. (FR)

22138 INVESTIGATION OF ELECTRON COMPONENT OF EXCESS RADIATION ON THE PROTON-3 ARTIFICIAL EARTH SATELLITE. Grigorov, N. L.; Kalinkin, L. F.; Pugacheva, G. I.; Savenko, I. A. Cosmic Res. (USSR) (Engl. Transl.); 11: No. 5, 718-719(1973).

Translated from Kosm. Issled.; 11: No. 5, 798-799(1973).

On the "Proton-3" artificial earth satellite, the studies of the fluxes and energy spectrum of electrons of excess radiation with energy $E_e \geq 10^8$ eV were continued. A more detailed treatment of the primary data was carried out. Use of the calculated-time "joining" of the trajectories of the satellite enabled the separation of sections of the orbit that occurred at an area with rigidity of geomagnetic cutoff $P \geq 10$ GeV/c. (MHR)

22139 FLUX DENSITIES OF ELECTRONS WITH ENERGIES ABOVE 10 MeV AT HEIGHTS OF 250 TO 500 KM ACCORDING TO MEASUREMENTS WITH THE PROTON 4 SATELLITE. Basilova, R. N.; Grigorov, N. L.; Kalinkin, L. F.; Klyachko, A. V.; Kogan-Laskina, E. I.; Lupenko, G. V.; Nagornykh, Yu. I.; Savenko, I. A. Cosmic Res. (USSR) (Engl. Transl.); 11: No. 5, 636-642(1973).

Translated from Kosm. Issled.; 11: No. 5, 710-717(1973).

Measurements of electron flux densities with the Proton 4 satellite are reported. A description is given of the instrument and its calibration. The principal results are presented in the form of electron spectra for the energy range 0.03–3.5 GeV at the equator and in high latitudes. For energies $E_e > 0.3$ GeV the spectra may be represented as power functions of the form $I_1 (\geq E) \approx 9 \cdot 10^{-4} E^{-1.0 \pm 0.2}$ for the equatorial zone ($P_1 \geq 10$ GeV/c) and $(I_2 \geq E) \approx 2.1 \cdot 10^{-3} E^{-1.5 \pm 0.1}$ for high latitudes ($P_2 \leq 2$ GeV/c). The electron flux densities measured in this experiment are compared with stratospheric measurements. (auth)

22140 CHEMISTRY OF POSITIVE IONS IN THE STRONGLY IONIZED MIDDLE-LATITUDE NOCTURNAL D REGION. I. Kozlov, S. I.; Pedorenko, V. F. Cosmic Res. (USSR) (Engl. Transl.); 11: No. 5, 648-652(1973).

Translated from Kosm. Issled.; 11: No. 5, 724-729(1973).

On the basis of the two-ion model of electron-ion recombination, the chemistry of positive ions in the strongly ionized middle-latitude nocturnal D-layer is examined. It is shown that even under such conditions the role of ions possessing a coefficient of recombination with electrons higher than the usual O_2^+ and NO^+ ions is quite large. The upper limit of the possible value of this recombination coefficient is evaluated and found to be equal to $\sim 10^{-5}$ cm^3/sec. (auth)

22141 CHEMISTRY OF POSITIVE IONS IN THE STRONGLY IONIZED MIDDLE-LATITUDE NOCTURNAL D REGION. II. Kozlov, S. I.; Pedorenko, V. F. Cosmic Res. (USSR) (Engl. Transl.); 11: No. 5, 653-660(1973).

Translated from Kosm. Issled.; 11: No. 5, 730-737(1973).

The chemistry of positive ions in the strongly ionized nocturnal middle-latitude D-region is studied in detail on the basis of current concepts of ion transformation processes at these altitudes. (auth)

22142 ELECTRON STREAMS AT HEIGHTS OF 100 TO 180 KM IN THE ARCTIC. Tulinov, V. F.; Feigin, V. M.; Tulinov, G. F.; Novikov, L. S.; Lipovetskii, V. A. Cosmic Res. (USSR) (Engl. Transl.); 11: No. 5, 631-635(1973).

Translated from Kosm. Issled.; 11: No. 5, 704-709(1973).

Investigations of incoming electrons are reported, as conducted with MR-12 meteorological rockets at heights up to 180 km in the polar zone (at Heiss Island, Franz Josef Land) during 1969 to 1971. The range of flux-density variation of the electrons is determined, as well as their energy spectra at energies above 40 keV. An analysis of solar and geomagnetic conditions during the period of the rocket flights indicates definite ways in which the incoming corpuscular radiation affects the polar thermosphere. (auth)

22143 EFFECTS OF ATMOSPHERIC TEMPERATURE GRADIENTS AND NEUTRAL WINDS ON THE LOW CUT OFF PERIOD OF GRAVITY WAVES. Gupta, A. B.; Nagpal, O. P.; Setty, C. S. G. K. (Univ. of Delhi). Ann. Geophys.; 29: No. 2, 301-305 (Apr 1973).

Experimental measurements on the F2 region critical frequency fluctuations reveal the presence of internal gravity waves with the cut off period as low as 7 min. This cut off is found to vary with season, being minimum in winter and maximum in summer at Delhi (Dip = angle 42.4°). It is found that atmospheric temperature gradients and neutral winds play an important role in determining this effective cut-off period of gravity waves. (FR)

22144 SOME STUDIES OF ATMOSPHERIC GRAVITY WAVES AT EQUATORIAL AND TEMPERATE LATITUDES. Nagpal, O. P.; Gupta, A. B.; Setty, C. S. G. K. (Univ. of Delhi). Ann. Geophys.; 29: No. 2, 293-300(Apr 1973).

Some studies of the F2 region critical frequency made at equatorial (Huancayo, dip = 2°) and temperate (Delhi, dip = 42°; Ahmedabad, dip = 34°) latitudes reveal the presence of atmospheric gravity waves in the ionosphere. The gravity, wave spectra obtained for the temperate latitude stations are found to differ from those for the equatorial station. Theoretical calculations are made to the effect that the ionospheric response to gravity waves is anisotropic and is a function of the magnetic dip of the station of observation. The experimental observations have thus been confirmed by theoretical calculations. (FR)

22145 F_2-REGION IONOSPHERIC RESPONSE TO ATMOSPHERIC GRAVITY WAVES. Gupta, A. B.; Nagpal, O. P. (Univ. of Delhi). Ann. Geophys.; 29: No. 2, 307-319(Apr 1973).

Extensive measurements of the small scale fluctuations in the F_2 region critical frequency made at Delhi (dip angle 42.4°) reveal the presence of atmospheric gravity waves which produce disturbances in the ambient electron density values at the F_2 region heights. These disturbances are found to be of perturbation magnitude; it is suggested that a simple theory based on perturbation treatment can be safely used to study the ionospheric response to gravity waves in the F_2 region. Such a theory predicts that this response is anisotropic and depends mainly on two factors: the inclination of the wave front with respect to the direction of magnetic field and the azimuth of wave propagation. The experimental results obtained by us corroborate this prediction and suggests that the waves observed propagated mainly in directions making a cone of about 60° around the plane of magnetic meridian. Spectrum analysis of the fluctuations in electron density show that there is a gradual fall in the amplitude of oscillations beyond about 60 min period. This is believed to be due mainly to the dissipation caused by molecular viscosity, thermal conductivity, and ion drag, the effects of which become significant at higher periods and at higher altitudes. (FR)

22146 EXTERNAL GEOPHYSICS. ISIS Working Groups. Taieb, C. (Centre National d'Etudes des Telecommunications, Issy-les-Moulineaux, France). Rech. Spatial; 13: No. 1, 20-22 (Jan 1974). (In French).

The ISIS program was set up in order to perform remote diagnostics of the ionosphere plasma (probe at higher level) and to carry out various complementary experiments (ion composition, temperature measurements, and particle detection). Each satellite was given a useful payload of increasing complexity. The ISIS working group is principally composed of participants and representatives of various countries, France's contribution to this group being that of installing remote measurement stations and of obtaining and analyzing data. Until April 1971, the group met every three or four months in order to discuss the characteristics of satellites currently being constructed using information obtained from orbiting devices and to interpret data acquired. Since then data meetings have been held at six to eight month intervals. (FR)

22147 TIDAL MOTIONS IN THE IONOSPHERE FROM SODIUM CLOUD DRIFTS. Kochanski, A. (National Oceanic and Atmospheric Administration, Silver Spring, MD). Ann. Geophys.; 29: No. 1, 77-87(Jan 1973).

Sodium drift data from heights up to 240 km and mostly from about 38° latitude were used to derive amplitudes and phases of a diurnal and a semidiurnal tidal term. An elementary technique was employed including several assumptions regarding tidal motions, but excluding the coexistence of a nontidal drift and short-period gravity waves. About 140 km, the height variations of the amplitude and phase of the derived 24-hour term bear a strong resemblance to the theoretical 1,-2 mode. The computed 12-hour term can be identified, to a lesser degree, with the 2,2 mode. The derived amplitudes (A12 and A24) suggest that from 130 to 240 km A12 > A24, but that from 240 to 300 km A24 > A12, with a factor of 1.4 involved at 300 km. However, the whole vertical structure shown by the derivations applies to soundings that came, on the average, from the midpoint of a solar cycle, while the available theories employ conditions appropriate to a solar minimum. Thus it is not unlikely that A12 > A24 at heights to at least 300 km, around solar minimum. (FR)

22148 SOLAR AND LUNAR EQUATORIAL ELECTROJETS. Gupta, J. C. (Dept. of Energy, Mines, and Resources, Ottawa). Ann. Geophys.; 29: No. 1, 49-60(Jan 1973).

The study of the average solar (S) and lunar (L) daily variations in the equatorial zone, data from seven stations from IGY/C, and from two of these stations for the period January 1953 to June 1955, are analyzed. It is found that: (1) The seasonal changes for S and L are about 7 and 90% respectively with the largest values in e season for S and d season for L. (2) For the above two periods the sunspot cycle effect on the solar daily variations is estimated to be slightly more than twice of that for the lunar daily variations. (3) The electrojets move north and south of a mean jet line in different seasons and also with increasing sunspot activity. (4) A single theoretical model does not seem to fit the observed S and L daily variations. (5) A stronger lunar current seems to flow in the ionosphere in those regions of the equatorial zone where the total field strength is smaller. (FR)

22149 EFFECT OF NEUTRAL WINDS ON IONOSPHERIC F-REGION AT A PAIR OF CONJUGATE STATIONS IN LOW LATITUDE. Deshpande, M. R. (PEL Geophysical Observatory, Christchurch, New Zealand). Ann. Geophys.; 29: No. 1, 43-47 (Jan 1973).

Differences in the behavior of the ionospheric F-region at a pair of conjugate stations (Rarotonga and Maui) at low latitude have been investigated by evaluating neutral winds and electron densities for the equinox period. During most of the day the electron density at Rarotonga is less than at Maui, while during nighttime the situation is reversed. A similar variation in hmF2 is also observed for most of the equinoxes. These differences can be explained qualitatively when neutral wind effects in the F-region are taken into consideration, except for (i) high sunspot years when hmF2 at Rarotonga is greater than that at Maui, even during daytime; (ii) for low sunspot years when hmF2 at Maui is greater than that at Rarotonga for a few hours in the early part of the night. The observed phase shift between the diurnal variation of hmF2 at Rarotonga and at Maui, particularly during nighttime, can be attributed to the phase shift in vertical drifts induced by neutral winds at these two stations. (FR)

22150 EFFECT OF MODIFIED THERMAL CONDUCTIVITY ON THE TEMPERATURE DISTRIBUTION IN THE PROTONOSPHERE. Mayr, H. G.; Fontheim, E. G.; Mahajan, K. K. (National Aeronautics and Space Administration, Greenbelt, MD). Ann. Geophys.; 29: No. 1, 21-24(Jan 1973).

At typical protonospheric electron densities the electron mean free path is sufficiently long so that the coefficient of thermal conductivity is no longer given by Spitzer's expression. The effect on the temperature profile of using the corrected expression for conductivity is investigated. The corrected thermal conduction coefficient is density-dependent and has a more complicated temperature dependence than the coefficient applicable to higher density plasmas. The results indicate that the effect is not negligible even under quiet conditions and at low latitudes. (FR)

22151 SELF-MODULATION OF A POWERFUL ELECTROMAGNETIC PULSE REFLECTED FROM THE UPPER LAYERS OF THE IONOSPHERE. Shlyuger, I. S. JETP Lett. (USSR) (Engl. Transl.); 19: No. 5, 162-163(5 Mar 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 19: No. 5, 274-276(5 Mar 1974).

Anomalous absorption and deep amplitude modulation of a radio pulse reflected from the F layer of the ionosphere have been observed. (auth)

Magnetospheric Phenomena

Refer also to abstract 22073.

22152 STATISTICAL ANALYSIS OF THE PITCH ANGLE DISTRIBUTION OF MAGNETOSPHERIC SOLAR PROTONS DURING GEOMAGNETIC ACTIVITY. Scholer, M.; Morfill, G.; Hovestadt, D. (Max-Planck-Institut fuer Physik und Astrophysik, Garching/Muenchen (F. R. Germany). Inst. fuer Extraterrestriche Physik). Z. Geophys.; 40: No. 1, 37-56(Feb 1974).

8 figs.; 22 refs.

The pitch angle distributions of energetic solar protons in the pseudo-trapping region were used in order to examine magnetospheric processes. Data from two instruments (viewing angle perpendicular and 45° with respect to the local geomagnetic field) on board the low altitude polar orbiting satellite GRS/Azur give a rough measure of the pitch angle distribution of energetic solar protons ($1.5 < E < 2.7$ MeV) over the polar cap. For several solar particle events the ratios of the counting rates of the two instruments were ordered according to invariant latitude, magnetic local time and geomagnetic activity. The geomagnetic activity was expressed by the time phase relative to the expansion of isolated substorms and the H-component of the magnetic field at a near midnight auroral station. Thus the analysis shows substrom-related effects on energetic particles in the pseudo-trapping region. (auth)

22153 DETERMINATION OF THE f_n, t_n PARAMETERS CHARACTERISTIC OF WHISTLERS RECEIVED ON EARTH. Corcuff, P.; Corcuff, Y. (Univ., Poitiers, France). Ann. Geophys.; 29: No. 2, 273-278(Apr 1973). (In French).

Using the (f,t) spectrum and a property of the $Q(f) = (t\sqrt{f})^{-1}$ function of a whistler, a method is described giving: either the nose frequency f_n and the minimum group delay t_n when it is possible to identify the causative atmospheric on the spectrogram; or the atmospheric time of occurrence and t_n when f_n is known. Since only algebraic relations are involved, it is well suited to digital computation. (FR)

22154 EXTERNAL GEOPHYSICS. French Participation in the GEOS Wave Experiment. Petit, M. (Centre National d'Etudes de Telecommunications, Issy-les-Moulineaux, France). Rech. Spatial; 13: No. 1, 6-9(Jan 1974). (In French).

Two French contributions were selected for the GEOS wave experiment: studies of electric and magnetic components of natural waves in the magnetosphere, and active plasma diagnostics using wave emission and reception. (FR)

22155 EXTERNAL GEOPHYSICS. Francosoviet ARAKS Project. Aubert, M. (Centre National d'Etudes Spatiales, Paris). Rech. Spatial; 13: No. 1, 9-14(Jan 1974). (In French).

Probe rockets will be used in the ARAKS experiment (active conjugate point experiment), an experiment which consists of injecting a beam of electrons along one of the lines of force of the earth's magnetic field and of studying the behavior of these electrons at the ends of this line (Kerguelen and Arkhangelsk) as a function of time. In this way, conjugate points can be located, and special phenomena studied together with wave generation phenomena. (FR)

22156 STUDY OF THE INTERACTION BETWEEN MONOCHROMATIC WAVES AND PARTICLES IN INHOMOGENEOUS MEDIA. Welti, R.; Pellat, R. (Ecole Polytechnique, Paris). Ann. Geophys.; 29: No. 2, 263-271(Apr 1973). (In French).

The distorted distribution function of protons, resonating with a monochromatic wave of ultralow frequency and of finite amplitude has been studied, taking into account the inhomogeneity of the medium. A transverse electromagnetic, left-handed polarized wave is considered, its amplitude being smaller than the amplitude for which trapping effects become important over the interaction length. During the linear phase, the wave which corresponds to the maximum growth rate is exponentially amplified. Due to this exponentiation, its spectrum becomes very narrow. When this wave reaches a sufficient level, particles are diffused and thus the corresponding growth rate has to decrease. On the other hand, the growth rate of neighboring waves is enhanced. Such a mechanism enables us to explain the appearance of satellite waves in the spectrum of micropulsation (pearls oscillations). These waves are generally observed on the ground, they result from cyclotron instability of approximately 50 keV protons. (FR)

22157 EXPERIMENTAL AND THEORETICAL STUDIES OF NONGUIDED WHISTLERS RECEIVED AT LOW LATITUDES ON BOARD THE ALOUETTE 2 SATELLITE. Charcosset, G. (Univ., Poitiers, France); Tixier, M.; Corcuff, Y.; Garnier, M. Ann. Geophys.; 29: No. 2, 279-291(Apr 1973). (In French).

New whistler phenomena, named NG (nonducted) whistlers, observed on Alouette 2 satellite records during March 1970 are described here. These whistlers are interpreted by nonducted ray tracing between conjugate hemispheres in an homogeneous magnetosphere. The evolution, with latitude, of their frequency-time spectra is remarkable and defines different reception areas. A lower cut-off frequency related to the local lower hybrid resonance (LHR) frequency, and a pseudo nose frequency characteristic of the nonducted mode are observed on traces received at latitudes higher than $L = 1,6$. Moreover, it is shown that, for the passes studied here, it is in the vicinity of this limit $L = 1,6$ that a nonducted wave is able to propagate, in the quasi-transverse (QT) mode, towards higher latitudes in the ionosphere and thus to produce QT whistlers. (FR)

22158 EFFECTS PRODUCED BY THE EQUATORIAL ELECTROJET IN CENTRAL AFRICA. Fambitakoye, O. (Office de la Recherche Scientifique et Technique Outre-Mer, Paris). Ann. Geophys.; 29: No. 2, 149-169(Apr 1973). (In French).

The contribution of the induced effects to transient magnetic variations observed in the region of the equatorial electrojet is estimated from a longitudinal chain of nine stations, forming a North–South profile of 3,000 km on each side of the magnetic equator in Central Africa. It is pointed out that such effects are negligible for the part of the regular daily variation S_R due to the equatorial electrojet, but their existence is quite clear for the part of the irregular perturbations due to the electrojet. Such difference is related to the difference in the causes of the induction: rotation of the earth in the case of S_R variation, variation of current intensity in the case of the perturbations. The opposite result, as for the S_R variation, obtained by Forbush and Casaverde (1961) is criticized. (FR)

PHYSICS (ATOMIC AND MOLECULAR)

Beams and Their Reactions

Refer also to abstracts 21697, 21698, 22705, and 23490.

22159 (KHFTI-72-45, pp 22-23) COHERENT BREMSSTRAHLUNG OF ELECTRONS AND POSITRONS ON CRYSTALS OF SILICON AND NIOBIUM. Grishaev, I. A.; Kasilov, V. I.; Kovalenko, G. D.; Morokhovskii, V. L.; Fisum, A. N. 1972. (In Russian).

A method for the experimental study of the coherent bremsstrahlung of electrons and positrons on crystals of Si and Nb was described and the results reported. The dependence of the secondary electron yield on the angle between the crystal axis and the direction of the electron beam was determined. The linear electron accelerator of the Physics-Technical Institute was used as a source of electrons. It was observed that the measured orientation dependence has a characteristic coherent maximum. The maximum, obtained experimentally, agrees well with calculated data. (tr-auth)

22160 OBSERVATION OF THE RESONANT STARK EFFECT AT OPTICAL FREQUENCIES. Schuda, F.; Stroud, O. R.; Hercher, M. (Rochester Univ., NY). J. Phys., B (London); 7: No. 7, L198-L202(11 May 1974).

The spectrum of resonantly scattered light at right angles to a sodium atomic beam is reported. The light source was a CW dye laser tuned to resonance with a hyperfine component of the D_2 line, and incident at right angles to the atomic beam. The spectrum, with the Stark effect sidebands, was recorded as a function of both the laser intensity and its detuning from resonance. The overall resolution is better than 20 MHz. (auth)

22161 MODEL OF MULTIPLE ION SCATTERING BY SOLID SURFACE. Labzin, V. G.; Skripka, Yu. G. (Donetsk State Univ., USSR). Dopov. Akad. Nauk Ukr. RSR, Ser. A; No. 5, 450-452 (1974). (In Russian).

A new method is suggested for calculating multiple ion scattering. The method is based on the solution of the inverse scattering problem. The data of the calculation are in good agreement with the obtained experimental results. (auth)

22162 HEAVY IONS SOLVE TECHNICAL PROBLEMS. Fljerow, G.; Baraschenkow, W. Bild Wiss.; 11: No. 4, 64-68 (Apr 1974). (In German).

9 figs.

Some aspects of the application of heavy ions for different purposes are presented: ion implantation for producing new semiconductors and for changing the refractive index of optically transparent films, for the production of new alloys and high-temperature supraconductors. Heavy-ion beams are also used in the surface treatment of materials (strengthening, passivation, polishing), for fast simulation of radiation-induced corrosion effects on structural reactor materials, for the fabrication of ultrafine filters ("nuclear filters" for sterilization, cell division, clinical diagnostics), for the irradiation of locally confined body areas and for the production of artificial isotopes with excess protons (proton emitters). (GE)

22163 INELASTIC SCATTERING OF X-RAYS BY LIGHT METALS. Matsudaira, N.; Nagai, S. (Nihon Univ., Funabashi, Japan). J. Phys. Soc. Jap.; 36: No. 1, 234-238(Jan 1974).

The scattering cross section of x rays inelastically scattered by an electron gas is calculated in the random phase approximation, for various scattering angles, making use of the formula previously derived by Ohmura and Matsudaira. When the angle is small, the profile deviates from the inverse parabolla due to the Pauli exclusion principle and to the electron-electron interaction. Especially when the angle is near θ_c, corresponding to the plasma cut-off wave number, a pronounced peak appears, reflecting plasmon emission. It is also shown that if a scattering angle is a little larger than θ_c, yet the "plasmon peak" survives. These features are in excellent agreement with the experiments of Suzuki and Tanokura, and Alexandropoulos. (auth)

22164 HIGH-CURRENT ALKALI ION SOURCE FOR SPUTTERING EXPERIMENTS. Bernhard, F.; Kerkow, H. (Humboldt-Univ., Berlin). Exp. Tech. Phys.; 21: No. 4, 317-323 (1973). (In German).

The design and the properties of a surface ionization source are described. The temperature of the heated surface and the vapor pressure can be varied independently assuring thereby a high long-term stability, efficiency and ion yield. For potassium, rubidium and cesium ions a current density of some mA/cm^2 was obtained with the portion of the foreign alkali ions being lower by 3 or 4 orders of magnitude, while that of the other impurities is lower by 4 or 5 orders of magnitude. (auth)

Atomic and Molecular Properties

Refer also to abstracts 22181, 22795, 22802, and 23037.

22165 STATIC EFFECTS IN HYDROGEN-LIKE ATOMS (RELATIVISTIC THEORY). Granovskii, Ya. I.; Nechet, V. I. (Donetsk State Univ., USSR). Yadern. Fiz.; 19: No. 6, 1290-1297(Jun 1974). (In Russian).

A method is presented to evaluate static effects in hydrogen-like atoms using the total Coulomb Green's function of the Dirac electron. In the second order of the perturbation theory explicit analytical expressions are obtained for the ground-state energy shift for the atom in a constant electromagnetic field. (auth)

22166 VIBRATION-ROTATION ENERGY TRANSFER OF FAST ROTATING MOLECULES. Tam, W. G. (Univ. Laval, Quebec). Can. J. Phys.; 52: No. 10, 854-860(15 May 1974).

A semiclassical theory of the vibration-rotation energy transfer of fast rotating molecules is presented. The formulation is based on the same model as that of Shin's classical theory. The semiclassical theory is simpler to derive and more rigorous. It is shown that it necessarily gives more accurate results than the classical theory. Applications to the systems HF and DF indicate that the two theories agree reasonably well in these cases. (auth)

22167 VARIATIONAL PERTURBATION TREATMENT OF THE HYDROGEN MOLECULAR ION USING THE GREEN FUNCTION METHOD ON THE UNITED ATOM. Corsaro, F. A.; Solenberger, F. R.; Hameka, H. F. (Univ. of Pennsylvania, Philadelphia). Int. J. Quant. Chem.; 8: No. 3, 319-333(May 1974).

The second-order perturbed energy and the first-order perturbed wave function of the hydrogen molecular ion by the Green function method based on a united atom with effective nuclear charge, Z, are calculated. Since the perturbation is given by $(Z/r)-(1/r_A)-(1/r_B)$, its magnitude depends on the parameter Z. One obtains an analytical expression for the second-order perturbed energy as a function of Z and the internuclear distance R. A variety of methods are discussed to determine the best values for Z and to derive the potential energy curve and the force constant for H_2^+; these methods vary in the accuracy of their results. (auth)

22168 CLASSICAL DYNAMICS: THE STUDY OF VIBRATIONAL AND ROTATIONAL EXCITATION IN Li^+, H_2. Brown, N. J. (Johns Hopkins Univ., Silver Spring, MD). J. Chem. Phys.; 60: No. 8, 2958-2965(15 Apr 1974).

Equations of motion based upon the exact solution of the Milne equation are used to perform trajectory calculations. Using the trajectory information charge densities are calculated for N fermions in a harmonic oscillator potential in a semiclassical approximation. The charge densities so obtained are in almost exact agreement with exact calculation within the outermost density maxima. Outside this region the differences between the approximate and exact densities are essentially independent of the number of fermions in the system. (auth)

22169 MEASUREMENT OF THE FINE STRUCTURE OF THE n = 4 STATE OF HYDROGEN. Brown, R. A.; Pipkin, F. M. (Harvard Univ., Cambridge, MA). Astrophys. J.; 80: No. 2, 479-519(Oct 1973).

A time-resolved spectroscopy technique was used to measure the fine structure of the n = 4 state of hydrogen. The excited hydrogen atoms were formed by the use of an electron beam to dissociate molecular hydrogen. The resonance transitions were observed by keeping the frequency field fixed and sweeping the magnetic field. Measurements on deuterium were used to study the effects of pressure and motional electric fields. The $^2S_{\frac{1}{2}} \rightarrow {}^2P_{\frac{1}{2}}$ Lamb shift transition L, the $^2P_{\frac{1}{2}} \rightarrow {}^2S_{\frac{1}{2}}$ fine structure interval $\Delta E - L$, and the ambient electric field in the measurement volume were determined by using measurements on three separate transitions made at fixed magnetic field. The measurements gave $L = 132\ ^{+0.28}_{-0.19}$ MHz and $\Delta E - L = 1237.79\ ^{+0.21}_{-0.32}$ MHz. (auth)

22170 ISOTOPE SHIFT OF THE BARIUM NUCLIDES ^{140}Ba, ^{138}Ba, ^{136}Ba, AND ^{134}Ba IN THE Ba II-RESONANCE LINE $6p^2P1/2-6s^2S1/2$. Fischer, W.; Hartmann, M.; Huehnermann, H. (Marburg Univ. (F.R. Germany). Fachbereich Physik); Vogg, H. (Kernforschungszentrum Karlsruhe (F.R. Germany). Lab. fuer Isotopentechnik). Z. Phys.; 267: No. 3, 209-217(Apr 1974). (In German).

3 Figures; 4 tables; 31 references.

The radioactive barium nuclide ^{140}Ba ($T_{\frac{1}{2}}$ = 12.8 d) was separated chemically from fission products of uranium. The scheme of the carrier-free separation is described. The isotope shift in the barium II resonance line $6p^2P1/2 - 6s^2S1/2$ at 4934 A was measured by means of a pressure scanned Fabry-Perot interferometer. The result $\Delta\nu(^{140}Ba - {}^{138}Ba) = -39.3$ (3.2) mK was used together with the remeasured isotope shift values of ^{138}Ba, ^{136}Ba, and ^{134}Ba to calculate the change of the mean square radius of the nuclear charge distribution. The results are compared with data for isotonic nuclides of neighboring elements. (orig.) (FF)

22171 MONTE CARLO CALCULATION OF THE FEYNMAN–COHEN EXCITATION SPECTRUM FOR HELIUM. Padmore, T. C. (Univ. of Toronto); Chester, G. V. Phys. Rev., A; 9: No. 4, 1725-1732(Apr 1974).

A Monte Carlo method is used to calculate the excitation spectrum of He II. The variational method and the trial wave function of Feynman and Cohen (FC) are used. No approximations, such as the Kirkwood superposition approximation, or estimates are employed. Important terms in the FC calculation are found to be in error by as much as 10 to 20% but the final answer, Δ = 11.2 K, at the equilibrium density, is hardly different from the FC value Δ = 11.5 K. Results of calculations for densities up to 1.2 times the equilibrium density (i.e., the freezing density) are also presented; it is found that the FC wave function does not lead to the expected pressure dependence of Δ. Some modifications to the usual Monte Carlo methods, necessary for this calculation, are discussed. (auth)

22172 ABSORPTION SPECTRUM OF D_2 FROM 1100 TO 840 Å. Dabrowski, A.; Herzberg, G. (National Research Council of Canada, Ottawa). Can. J. Phys.; 52: No. 12, 1110-1136(15 Jun 1974).

The absorption spectrum of D_2 has been studied in absorption at high resolution (0.254 Å/mm) in the region 1100 to 840 Å. The three band systems $B^1\Sigma_u^+ \leftarrow X^1\Sigma_g^+$ (Lyman bands), $B'^1\Sigma_u^+ \leftarrow X^1\Sigma_g^+$, and $C^1\Pi_u \leftarrow X^1\Sigma_g^+$ (Werner bands) have been measured right up to the dissociation limit. New improved values of the rotational and vibrational constants in the three upper states have been derived. By comparing the electronic energy differences T_e thus obtained with the corresponding values for H_2 fairly precise values for the electronic isotope shifts for the B–X and C–X systems have been determined (+2.8 and −7.4 cm^{-1}, respectively). In this connection two gaps in the knowledge of the absorption spectrum of H_2 have been filled: the Lyman bands with v' = 5–16 and the Werner bands with v' = 0–4. A detailed comparison is made of the observed vibrational levels and the observed B_v values of D_2 with those derived from ab initio calculations based on the Kolos and Wolniewicz' potential functions. From the observed electronic isotope shift the adiabatic corrections can be estimated near the minimum. For the B state these estimates agree very well with the ab initio calculations. The remaining differences between observation and theory are partly due to lack of convergence of the Born–Oppenheimer calculation, partly to the neglect of nonadiabatic corrections. The convergence error near minimum is estimated to be 5.1 cm^{-1} for the B state and 1.2 cm^{-1} for the C state. (auth)

22173 SPECTRA OF $(H_2)_2$, $(D_2)_2$, AND $H_2 - D_2$ VAN DER WAALS COMPLEXES. McKellar, A. R. W.; Welsh, H. L. (Univ. of Toronto). Can. J. Phys.; 52: No. 12, 1082-1089(15 Jun 1974).

Spectra due to the Van der Waals complex $(H_2)_2$ have been obtained with greatly improved resolution, and analogous spectra of $(D_2)_2$ and $H_2 - D_2$ have been observed. The experiments were conducted with an absorption path of 110 m in a multiple traversal cell at temperatures between 16 and 21 K. The spectra are manifested as fine structure accompanying the single and double H_2 (or D_2) transitions in the hydrogen (or deuterium) collision induced fundamental band. The observed structure for $(H_2)_2$ and $H_2 - D_2$ can be unambiguously assigned to rotational transitions of the complex governed by the selection rule $\Delta l = \pm 1, \pm 3$, where l is the rotational quantum number of the complex. A detailed analysis must include anisotropic force effects, and is not given here. The spectrum of $(D_2)_2$ is complicated, not only by anisotropic force effects, but also by mutual perturbations between the rotational levels of the upper states of corresponding single and double D_2 transitions; for this reason, the assignments suggested are somewhat uncertain. An interesting intensity alternation apparent in part of the $(D_2)_2$ spectrum is explained as a simple effect of nuclear spin statistics in the pseudodiatomic molecule $(D_2)_2$. (auth)

Positronium, Muonium, and Muonic and Mesic Atoms and Molecules

Refer also to abstracts 22411 and 22412.

22174 (CERN-74-8, pp 93-191) POSITIVE MUONS IN CONDENSED MEDIA. Schenck, A.; Crowe, K. M. (Univ. of California, Berkeley). 10 Apr 1974.

From intermediate energy physics meeting; Zuoz, Switzerland (13 Apr 1973).

Lectures are given on the application of positive muons as probes in condensed media physics and chemistry. The basic muon properties, experimental methods, experimental types of muon depolarization phenomena and complete phenomenological rate distribution formulas, muonium, experimental observations and speculations up to 1966, and the slowing down process and the status of the muon afterwards. Also, muon precession at the quasi-free Larmor frequency and slow depolarization in solids, slow depolarization in paramagnetic liquids, quasi-free muonium evolution, muonium chemical reactions, muonium in solid insulators and semiconductors, and a comparison with other methods are covered. (JFP)

22175 (JINR-D1-7300) MEASUREMENT OF MUON CAPTURE RATE IN GASEOUS HYDROGEN. Bystritskii, V. M.; Dzhelepov, V. P.; Ermolov, P. F.; Oganesyan, K. O.; Omel'yanenko, M. N.; Porokhovoi, S. Yu.; Roganov, V. S.; Rudenko, A. I.; Fil'chenkov, V. V. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1973. 36p. (In Russian). INIS.

Nuclear capture of muons by protons was studied in experiments with gaseous hydrogen targets on a muon beam from the JINR synchrocyclotron; 278 ± 33 events were recorded. The capture rate, 686 ± 88 per second, agreed with that predicted by the theory of universal 4-fermion interaction indicated a V-A variant of this theory. (tr-auth)

22176 POSITRON ANNIHILATION IN SOLID HYDROCARBONS. Goworek, T.; Waryszczuk, J.; Gustaw, W.; Rybka, C. (M. Curie-Skodowska Univ., Lublin). Phys. Status Solidi (b); 63: No. 1, L69-K74(1 May 1974).

The momentum distribution of annihilating pairs in anthracene and phenanthrene, deduced from measurements of the angular distribution of annihilation radiation is presented. (JFP)

22177 FORMATION OF PIONIC AND MUONIC ATOMS IN LIQUID HELIUM AND HYDROGEN. von Egidy, T.; Backenstoss, G.; Egger, J.; Hagelberg, R.; Herrlander, C. J.; Koch, H.; Povel, H. P.; Schwitter, A.; Tauscher, L. (CERN, Geneva). pp 299-302 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973). See CONF-730642-.

After stopping of muons in liquid hydrogen a delayed 8.12 ± 0.07 keV line and a 5 495 ± 6 keV line were observed with Si(Li) and Ge(Li) detectors. The 8.12 keV line may correspond to the muonic transition from the molecular pμd state to the 1s-μ^3He state. The 5 495 keV line is the binding energy of the fusion pμd → ^{3}He. An attempt was made to reproduce the measured absolute yields of muonic and pionic transitions in liquid helium with cascade calculations including external Auger effect, sliding transitions and for the pions nuclear absorption. The 3p-1s transition is more intensive than the 2p-1s transition. This cannot be achieved by cascade calculations including different formulas for nuclear absorption. (auth)

22178 REMARKS RELEVANT TO FINE STRUCTURE MEASUREMENTS OF MUONIC HYDROGEN AND MUONIC HELIUM. Huang, K. N. (Yale Univ., New Haven); Hughes, V. W.; Lewis, M. L.; Mueller, R. O.; Rosenthal, H.; Wu, C. S.; Camani, M. pp 312-314 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973). See CONF-730642-.

The possibilities of measuring energy levels in two simple muonic atoms, muonic hydrogen (μ^-p) and the muonic helium atom ($\alpha\mu^-e^-$) is discussed. (auth)

22179 SOLID STATE PHYSICS. Crowe, K. M. (Univ. of California, Berkeley). pp 445-450 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973). See CONF-730642-.

A review of μ^+ precession experiments is presented. The behavior of the spin of the muon as it interacts in different solids and liquids is discussed, as is muonium formation, "fast" depolarization, and slower relaxation in solids and solution with various chemical and magnetic ions. The interpretation of mu-

onium hyperfine spectra in germanium and silicon, as well as the recently observed anomalous μ^+ precession in silicon, are presented. The use of muons to probe internal magnetic fields in ferromagnets is also reported. (auth)

22180 SEARCH FOR TWO-QUANTUM ANNIHILATION OF POSITRONS IN FLIGHT WITH K-SHELL ELECTRONS. Nagatomo, T.; Nakayama, Y.; Morimoto, K.; Shimizu, S. (Kyoto Univ.). Phys. Rev. Lett.; 32: No. 21, 1158-1161(27 May 1974).

The two-quantum annihilation of positrons in flight with K-shell electrons of silver was investigated by using 300-keV positrons. The experimental result, $(7.7 \pm 6.4) \times 10^{-27}$ cm^2/sr^2, was obtained for the double-differential angular cross section of this process, at 30 and −100° for each annihilation photon with respect to the incident positron direction. (auth)

Collision Phenomena

Refer also to abstract 22734.

22181 (NP-20044, pp 87-92) INNER-SHELL EXCITATION BY N IONS AND ALPHA PARTICLES. I. Awaya, Y.; Hamada, T.; Okano, M.; Hashizume, A.; Takahashi, T.; Izumo, K.; Tendow, Y.; Katou, T. Dec 1973.

22182 (NP-20044, pp 93-97) INNER-SHELL EXCITATION BY N IONS AND ALPHA PARTICLES. II. Izumo, K.; Tendow, Y.; Awaya, Y.; Katou, T.; Okano, M.; Hashizume, A.; Takahashi, T.; Hamada, T. Dec 1973.

22183 (UCRL-75708) ELECTRON EXCITATION OF HIGH PRESSURE Ar, Kr, AND Xe. Ebert, P. J.; Koehler, H. A.; Ferderber, L. J.; Redhead, D. L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 21 May 1974. 6p. (CONF-740711-3). Dep. NTIS $4.00.

From 4th international conference on atomic physics; Heidelberg, F.R. Germany (22 Jul 1974).

High pressure Ar, Kr, and Xe were excited with high current bursts of relativistic electrons at 100 keV. The spectral and temporal characteristics of the vacuum ultraviolet continua centered near 126 nm in Ar, 150 nm in Kr and 170 nm in Xe were studied. The pressure dependence of the buildup and decay time constants is shown. (JFP)

22184 ELASTIC SCATTERING OF ELECTRONS BY ATOMIC HYDROGEN AT INTERMEDIATE ENERGIES. Byron, F. W.; Joachain, C. J. (Massachusetts Univ., Amherst). J. Phys., B (London); 7: No. 7, L212-L215(11 May 1974).

It is shown that the eikonal-Born series method agrees well with the recent experimental data of Teuber et al (J. Phys. B. Atom. Molec. Phys.; 6: L247-9 (1973)) for elastic scattering of electrons by atomic hydrogen. Other theoretical results (Born, Glauber, static potential) are compared and the wave number and the momentum transfer dependence of the successive terms in the Born and Glauber series analyzed. (auth)

22185 DETERMINATION OF THE MEAN EXCITATION ENERGY OF THE COPPER ATOMS BY IONIZATION RANGE OF 660 MeV PROTONS. Zrelov, V. P.; Krugiov, S. P.; Mus, K. F.; Savel'ev, V. D.; Shulek, P. (Leningrad Inst. of Nuclear Physics). Yadern. Fiz.; 19: No. 6, 1276-1281(Jun 1974). (In Russian).

The inconsistence of the various published values of the mean excitation energy of the copper atom I_{Cu} made one measure the "range−energy" relation for 660 MeV protons using a new method of measuring and analyzing the Bragg's curve and more precise measurements of the proton kinetic energy. Analysis of the data (R_{Cu} = (260.04 ± 0.34) G/cm^2; $\bar{E}$ = (260.0 ± 0.3) MeV) yields the value I_{Cu} = (320 ± 4) eV. The results have helped to explain the difference of the values obtained by using various methods of measuring the range of high energy protons. The experimental methodics and the data processing procedure are described taking into account the energy inhomogeneousness of the beam, the fluctuation in the ionization range, the multiple Coulomb scattering, and nuclear interaction of protons with matter. (auth)

22186 LOCALIZED ORBITALS AND SHORT-RANGE MOLECULAR INTERACTIONS. I. Theory. Magnasco, V.; Musso, G. F. (Univ., Genoa). J. Chem. Phys.; 60: No. 10, 3744-3748(15 May 1974).

The separation of the electronic energy into Coulombic and penetration components [V. Magnasco, G. F. Musso, and R. McWeeny, J. Chem. Phys. 47, 4617 (1967)] in the case of a (closed-shell) single determinant wave function of nonorthogonal localized spin bond orbitals (BO) is studied on the basis of a convenient density matrix formulation. The main correction that results when overlap is admitted consists of two terms, the first describing the energy of the density "perturbation" in the field of the "unperturbed" one-electron operator $\hat{F}_0$, the second the Coulomb-exchange self-interaction of the density "perturbation." When the groups interacting at short range are atoms or molecules, compact closed formulas for the interaction energies can be derived, and the connection with first-order perturbation theory is discussed. The present formalism is suitable for analyzing both nonadditivity of short-range intermolecular forces and the nature of barriers to internal rotation in molecules. (auth)

22187 ELECTRON IMPACT ON He AND He$^+$. 2. Coupling Effect in the Distorted Wave Polarized Orbital Approximation. McDowell, M. R. C.; Myerscough, V. P.; Narain, U. (Royal Holloway Coll., London). J. Phys., B (London): 7: No. 7, L195-L197(11 May 1974).

Coupling terms which were previously omitted are retained in a distorted wave polarized orbital calculation of electron impact excitation of the 1s → 2s transition in H and He$^+$. The results for H are in very good agreement with the best close coupling results at low energies. For He$^+$ the previous results are reduced by 18% at threshold, and fall 50% below experiment there. (auth)

22188 COULOMB-PROJECTED BORN APPROXIMATION. 4. Ionization of Hydrogen. Geltman, S.; Hidalgo, M. B. (Joint Inst. for Lab. Astrophysics, Boulder, CO). J. Phys., B (London); 7: No. 7, 831-839(11 May 1974).

The triple differential cross section for the electron impact ionization of hydrogen atoms is calculated in the Coulomb-projected Born approximation, including exchange, and detailed comparison is made with the ordinary Born result. The calculations are done for a variety of energies and angles of the two secondary electrons in coplanar and noncoplanar geometries. Appreciable differences occur in the results predicted by the various approximations. (auth)

22189 DYNAMIC CHARGE-STATE DEPENDENCE OF THE K VACANCY PRODUCTION YIELD IN HEAVY-ION ATOM-COLLISIONS AT KeV ENERGIES. Fastrup, B.; Boeving, E.; Larsen, G. A.; Dahl, P. (Aarchus Univ., Denmark). J. Phys., B (London); 7: No. 7, L206-L209(11 May 1974).

The KLL Auger electron production cross section was measured for collisions between Na^+, Na^{2+}, Ne^+, and N^+ ions and Ne and N_2 targets. Over a narrow velocity range (0.3 to 0.9 au), the data reveal a dramatic dynamic effect in the 2pπ vacancy occupation probability factor N_π. This is in contrast to current available theories which invoke a static factor N_π. (auth)

22190 USE OF SECOND ORDER POTENTIALS IN THE THEORY OF SCATTERING OF CHARGED PARTICLES BY ATOMS. 7. The Partial Wave Formalism and Elastic Scattering of Electrons by Hydrogen and Helium. Winters, K. H.; Clark, C. D.; Bransden, B. H.; Coleman, J. P. (Durham Univ., Eng.). J. Phys., B (London); 7: No. 7, 788-798(11 May 1974).

The second order potential approximation of Bransden and Coleman (J. Phys. B. Atom. Molec. Phys.; 5: 537-45 (1972)) is applied in a partial wave formalism to the elastic scattering of electrons from hydrogen and helium atoms. Differential, integrated, and total cross sections are presented for hydrogen in the energy range 100 to 200 eV and for helium in the range 50 to 500 eV. A one-channel approximation is used and the effect of exchange is included to first order in the potential. Conclusions are drawn as to the validity of the impact parameter approximation used in previous applications of the method. (auth)

22191 INELASTIC SCATTERING OF ELECTRONS AND PROTONS BY ATOMS AT INTERMEDIATE ENERGIES. Pt. 2. Joachain, C. J.; Vanderpoorten, R. (Univ., Brussels). J. Phys., B (London); 7: No. 7, 817-830(11 May 1974).

The eikonal distorted wave method is used to analyze the inelastic scattering of electrons and protons by helium atoms at intermediate energies. Detailed calculations are performed for the excitation of the 2^1S and 2^1P states. (auth)

22192 DIFFERENTIAL CROSS SECTIONS FOR ELASTIC AND INELASTIC HYDROGEN−HELIUM COLLISIONS. Flannery, M. R.; McCann, K. J. (Georgia Inst. of Tech., Atlanta). J. Phys., B (London); 7: No. 7, 840-849(11 May 1974).

The elastic and the 2s and 2p inelastic scattering of ground-state hydrogen atoms by helium is examined in the Born, unitarized-Born and multistate impact-parameter formulation of heavy-particle collisions, with incident energies E in the range $6.25 \le E \le 225$ keV. The failure of Born's approximation to provide an adequate description of both small angle elastic and inelastic scattering and large-angle inelastic scattering is graphically displayed. (auth)

22193 CROSS SECTIONS AND SINGULARITIES OF RESONANT CHARGE EXCHANGE OF CALCIUM, STRONTIUM, AND BARIUM IONS. Gaev, G. S.; Shpenik, O. B. (Uzhgorod State Univ., USSR). JETP Lett. (USSR) (Engl. Transl.); 19: No. 4, 128-130(20 Feb 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 19: No. 4, 209-212(20 Feb 1974).

A new procedure is proposed for measuring the total cross sections for the charge exchange of ions with atoms. The energy dependence of the resonant charge-exchange cross sections of the ions Ca^+, Sr^+, and Ba^+ are investigated in the range from 6 to 1000 eV, where regular oscillations are observed. (auth)

22194 EXPERIMENTAL INVESTIGATION OF THE EXCITATION OF THE HELIUM-ION RESONANCE LINE IN ELECTRON–ION COLLISIONS. Dashchenko, A. I.; Zapesochnyi, I. P.; Imre, A. I. (Uzhgorod State Univ., USSR). JETP Lett. (USSR) (Engl. Transl.); 19: No. 4, 137-138(20 Feb 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 19: No. 4, 223-225(20 Feb 1974).

The excitation function of the $\lambda = 30.4$ nm resonance line of the helium ion was measured by the method of intersecting modulated electron and ion beams. The experimental results are compared with calculations in the first and second Coulomb-Born approximation and in the strong-coupling approximation. (auth)

22195 K-SHELL IONIZATION CROSS SECTIONS OF SELECTED ELEMENTS FROM Fe TO As FOR PROTON BOMBARDMENT FROM 0.5 TO 2.0 MeV. Lear, R. D. Denton, TX; North Texas State University (1973). 73p. University Microfilms Order No. 74-14,823.

Thesis (Ph. D.).

Measurements made in this investigation have a two-fold use. They add to needed information for testing theoretical calculations of inner atomic electron shell ionization by ion impact. The second use of these measurements is in the field of application of x-ray analysis. K-shell ionization and x-ray production cross sections were measured for proton impact in the range 0.5 to 2.0 MeV. Ionization cross sections for Fe, Co, Cu, Zn, Ga, Ge, and As were 242 ± 23, 173 ± 15, 94.1 ± 7,8, 70.9 ± 6.9, 56.4 ± 4.6, 36.5 ± 2.7, and 27.1 ± 2.1 barns, respectively, at 2.0 MeV. These measurements agree to within less than 17 per cent with predictions of the binary encounter approximation (BEA) and the plane-wave Born approximation (PWBA) with binding energy corrections. The predictions of the PWBA exceed the measured values by as much as a factor of two at the maximum deviation. It is concluded that the BEA and PWBA with binding energy corrections continue to give a superior prediction to the PWBA over the proton energy range 0.5 to 2.0 MeV. These measurements also indicate a trend for measured ionization cross sections to drop below predictions for all three theories for low projectile energies, as well as an increasing disagreement between measurements and predictions of the BEA and corrected PWBA as the atomic number of the target decreases. (RWR)

22196 SEMICLASSICAL TREATMENT OF BOUND STATE SYSTEMS. II. Trajectory Calculations Using the Exact Quantum Momentum. Starkschall, G.; Light, J. C. (Univ. of Chicago). J. Chem. Phys.; 60: No. 8, 3032-3036(15 Apr 1974).

A classical study of translational, rotational, and vibrational energy exchange in the system Li^+, H_2 is presented. The potential surface used was the ab initio Lester surface appropriate for rotational and vibrational energy transfer studies. The effect of initial energy configuration and orientation variables on the energy transfer processes was studied. A central force calculation of the deflection function was made for comparison with that obtained from an anisotropic potential. The primary mode of energy transfer to the internal degrees of freedom is from translational energy. (auth)

22197 MULTISTATE EIKONAL TREATMENT OF ELECTRON-ATOM COLLISIONS. Flannery, M. R.; McCann, K. J. (Georgia Inst. of Tech., Atlanta). J. Phys., B (London); 7: No. 7, L223-L227(11 May 1974).

The basic equation for the scattering amplitude as determined from a multistate eikonal description of electron-atom collisions is presented. The relation with other semiclassical treatments is examined. Four-state eikonal calculations of the cross sections for elastic and the 2s and 2p excitations of H(1s) by electrons with incident energy E in the range $13.6 \text{ eV} \leq E \leq 200$ eV are carried out, and are compared with other refined theoretical treatments and with experiment. (auth)

22198 EXCITATION OF RESONANCE LINES OF Rb II AND Cs II BY ELECTRON ATOM COLLISIONS. Vukstich, V. S.; Aleksakhin, I. S.; Goldovs'kii, V. L. (Uzhgorod State Univ., USSR). Dopov. Akad. Nauk Ukr. RSR, Ser. A; No. 5, 445-447(1974). (In Russian).

The excitation process of single ionized rubidium and cesium spectral lines is studied, employing a crossed beam technique. The measured emission spectra in the spectral region between 50 and 100 nm showed the most effective excitation corresponds to the $ns'[1/2]_1^1$, $ns[1\frac{1}{2}]_1^1$ and $(n-1)d[1\frac{1}{2}]_1^1$ resonance energy levels. Relative cross sections of these levels are measured from the threshold to 200 eV. Sharp maxima are observed on the curves at energies equal to two threshold units. The obtained results are essential for understanding the mechanism of alkali atom inner electron ionization. (auth)

22199 X RAY PRODUCTIVE CROSS SECTIONS. 4f Σ Electron Promotion. Fortner, R. J. (California Univ., Livermore). J. Phys., B (London); 7: No. 8, L240-L243(1 Jun 1974).

The total L x ray production cross sections in P, S, Cl, Ar and K-Ar collisions are reported. A dramatic Z-dependence is observed. The Z-dependence is tentatively explained in terms of changes in fluorescence yield and the properties of the 4f σ molecular orbital. (auth)

22200 SEMI-CLASSICAL UNIFORM APPROXIMATION IN PENNING IONIZATION. Bieniek, R. J. (Harvard Univ., Cambridge, MA). J. Phys., B (London); 7: No. 8, L266-L270 (1 Jun 1974).

The uniform approximation is used to evaluate the semiclassical S-matrix for Penning ionization. The energy spectrum of the electron ejected in the Penning process: $He^*(1s2s, {}^3S) + H(1s, {}^2S) \rightarrow He(1s^2, {}^1S) + H^+ + e^-$ (ϵ) is calculated numerically. The results compare favorably to quantal calculations. (auth)

22201 UNIFIED DESCRIPTION OF THE PROFILE OF THE RESONANCE $2s^2\ {}^1S$ OF HELIUM IN PROTON–HELIUM COLLISIONS (33 keV TO 500 keV). Bordenave-Montesquieu, A.; Benoit-Cattin, P.; Rodiere, M.; Merchez, H.; Gleizes, A. (Univ., Toulouse). J. Phys., B (London); 7: No. 8, L254-L258(1 Jun 1974).

A method is proposed which clarifies the complicated results obtained for the Shore parameter a and the Fano parameter $\tilde{q}$, by a parametrization of energy spectra of electrons ejected in H^+-He collisions, with Shore's formula for the resonance $2s^2\ {}^1S$. By extending the observations for this resonance outside the energy range of 33 to 150 keV a generally good agreement is obtained with the results obtained previously. (auth)

22202 COULOMB IONIZATION OF THE L SUB-SHELLS BY HEAVY CHARGED PROJECTILES. Hansteen, J. M.; Johnsen, O. M.; Kocbach, L. (Bergen Univ., Norway). J. Phys., B (London); 7: No. 8, L271-L274(1 Jun 1974).

Some features of the Coulomb ionization probabilities for the L sub-shells of a heavy target atom are investigated by use of the semi-classical (SCA) model in impact parameter form. Based on hydrogen-like target electron wave functions, a few predictions on energy and impact parameter variations for individual sub-shells are given. (auth)

22203 STUDIES OF THE POTENTIAL-CURVE-CROSSING PROBLEMS. III. Collisional Spectroscopy of Close Crossings. Delos, J. B. (Coll. of William and Mary, Williamsburg, VA). Phys. Rev., A; 9: No. 4, 1626-1634(Apr 1974).

Using a previously developed semiclassical theory of electronic excitations, the cross sections that result from potential-curve crossings are calculated for a model system. The phenomena appearing in the differential cross sections are displayed and discussed. (auth)

22204 ELASTIC SCATTERING OF VERY SLOW ELECTRONS BY MOLECULES. Chang, E. S. (Univ. of Massachusetts, Amherst). Phys. Rev., A; 9: No. 4, 1644-1655(Apr 1974).

The modified effective-range theory, which has enjoyed great success in its application to electron-atom scattering, is hereby extended to electron scattering from molecules. An analytic expression for the diffusion cross section for molecules in any rotational state is obtained. It is utilized to analyze the detailed results of recent swarm experiments on H_2, and to comment on the less detailed experimental results on D_2, N_2, and O_2. (auth)

22205 POSITRON–HELIUM SCATTERING CROSS SECTIONS AND PHASE SHIFTS BELOW 19 eV: ADDENDUM. Jaduszliwer, B.; Paul, D. A. L. (Univ. of Toronto). Can. J. Phys.; 52: No. 11, 1047-1049(1 Jun 1974).

We have extended the phase shift analysis of our positron–helium transmission experiments to determine the importance of cross correlation between the s and p wave phase shifts in a previous paper. We have found out that using Humberston's s wave phase shifts with suitably modified p and d wave phase shifts leads to as good a fit to our experimental data as Drachman's s wave phase shifts. Preliminary values of total cross section are given in the 19 to 27 eV energy region. (auth)

22206 $Z^{\frac{1}{2}}$ DEPENDENCE OF K-SHELL IONIZATION CROSS SECTIONS AT 7.1 MeV/amu. Cue, N.; Dutkiewicz, V.; Sen, P.; Bakhru, H. (State Univ. of New York, Albany). Phys. Rev. Lett.; 32: No. 21, 1155-1157(27 May 1974).

Relative K-shell ionization cross sections were measured for 7.1-MeV/amu projectiles of He^{2+}, B^{5+}, C^{6+}, N^{7+}, O^{8+}, F^{9+}, and Ne^{10+} on targets of Ca, Fe, Y, and Cd. The scaled cross section ratios $R = [4\sigma(Z_1)]/[Z_1^2\sigma(2)]$ exhibit linear Z_1 dependence characteristic of the effects of increased binding of target electrons and polarization. The absence of higher-order Z_1 dependence suggests that the contributions to the ionization σ by charge exchange to the empty orbitals of the projectile are relatively small. (auth)

Atomic Theory

22207 (IPP-III-13) JOINT STATISTICAL COUNT OF FREE AND BOUND ELECTRON STATES. Klueber, O.; Wulff, H. (Max-Planck-Institut fuer Plasmaphysik, Garching/Muenchen (F. R. Germany)). Jun 1974. 21p. (In German). Dep. NTIS (US Sales Only) $4.25.

As far as we can see, it is not common to make a joint count of all the electron states, bound and free. Rather are the bound states considered first. Because the electron eigen-functions do not overlap, it is possible to apply the Boltzmann statistics here. The population of an energy level (Boltzmann factor) can be obtained by normalizing the distribution function obtained to the number of all neutral particles (= number of all bound electrons for hydrogen). The number of all neutral particles is, however, by no means known in advance. It follows from the Saha equation. To derive this, one has to consider the process H-ion + electron ⇌ H-atom. The exact treatment of this process is possible by, for example, the Darwin-Fowler saddlepoint method. In the following one does not want to consider these various particle species that interact with each other but to give only the electrons and one uniform count of all electron states, i.e., bound and free. The search for the enthropy maximum then furnishes, as usual, the equilibrium distribution. The latter is described by formulas from which one can derive the Boltzmann coefficient, Maxwell-Boltzmann velocity distribution function of free electrons and the Saha equation. (auth)

22208 COUPLING OPERATOR METHOD. Hirao, K. (Kyoto Univ.). J. Chem. Phys.; 60: No. 8, 3215-3222(15 Apr 1974).

The coupling operator method in the general SCF theory is discussed in terms of the projection operator property of the density operator. The advantage of using the density operator is that one can put the arbitrariness of the general SCF orbitals in evidence. It is shown how to put the fundamental condition for the optimum orbitals of the general SCF theory into a more general and useful form. The essential point of the coupling operator is how the variational conditions are included as the projections onto the intermanifolds. By using the arbitrariness of the manifold, one indicates how a modified SCF theory is developed, where by choosing an appropriate operator one can get any desired modified orbitals and their associated orbital energies under orbital transformations. An extension is given of Koopmans' theorem as an application of the modified SCF theory. Finally the effective Hamiltonian is derived which is valid for almost all of the proposed SCF theory. (auth)

22209 AN IMPROVED HELLMAN-TYPE PSEUDOPOTENTIAL FOR ATOMS AND MOLECULES. Pohl, H. A.; Fowler, D. R. (Oklahoma State Univ., Stillwater). Int. J. Quant. Chem.; 8: No. 3, 435-450(May 1974).

The concept of pseudopotentials offers much attractiveness for the quantum mechanical evaluation of the physical properties of atoms and molecules. The ideas of Hellmann, in which the repulsive and fermion character of inner electrons can be mimicked by an experimentally fitted, exponentially damped potential term, are especially attractive. Unfortunately, it is found that such a simple expression can only be used in a very limited number of cases, such as for the alkali metals, and even then fails for the simple case of lithium. It is shown that the Hellmann idea can readily be extended by including a second "shielded potential" term evaluated from tabulated previous Hartree–Fock calculations. The new expression for the model pseudopotential is both simple and effective. With it, the inner potential of any of the alkali metal atoms, including lithium, can be represented so that calculation of the molecular properties of the metal dimers can be accomplished. Calculations for Li_2, Na_2, and K_2 show the binding energies and equilibrium interatomic distances to be quite well given, in agreement with both chemical experience and spectroscopic evidence. (auth)

22210 PHOTOELECTRON SPECTROSCOPY. An Introduction to Ultraviolet Photoelectron Spectroscopy in the Gas Phase. Eland, J. H. D. New York; John Wiley and Sons, Inc. (1974). 248p. $18.50.

The topics discussed include principles of photoelectron spectroscopy, experimental method, ionization, electronic energies of ionic states, photoelectron band structure, degenerate ionic states, dissociations of positive ions, and applications in chemistry. (JFP)

PHYSICS (ELECTROFLUID AND MAGNETOFLUID)

22211 (FEI-406) SOME QUESTIONS OF THE THEORETICAL BASIS OF THE MAGNETIC METHOD FOR MEASURING VELOCITIES IN CANALS OF COMPLEX FORM. Mikhin, V. I.; Zhukov, A. V.; Ushakov, P. A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1973. 64p. (In Russian). Dep. NTIS (US Sales Only) $6.25.

An analytical solution was presented of the problem of the distribution of the energy potential during the flow of electroconducting fluids with any velocity profile in channels of complex form placed in an external magnetic field. The size of the cylindrical rods with permanent magnets placed in them seem to be characteristics of the channels. The conductivity of the rods can differ from the conductivity of the fluid or agree with it. The conductivity of the walls of the channel coincides with the conductivity of the fluid. The solution of this problem, coinciding according to form with the problem on the streamlining of a single rod with a flow with any velocity profile, was represented in the form of integrals from the product of the velocity at a point in some "weighting" functions. The solution of the problem for rods streamlined by any fluid flow was obtained by use of the corresponding conform representation from solutions for circular tubes with any velocity profile of the flow. By use of the conform representation a solution was given for the case of rods with highly electroconducting walls. The effect on the signal size by opposite electrodes of the transducer of the channel walls, the effect of the size of the gap, and the effect of the curvature of the wall were studied. Special attention was given to an analysis of the weighting function, determining the contribution of the individual regions of flow to the signal. On the basis of the analysis conclusions were drawn on the dimensions of the area giving the basic contribution to the signal size. The solution was carried out with neglect of the induced magnetic field and the effect of the magnetic field on the hydrodynamics of the coolant. (tr-auth)

22212 CONSTRUCTION OF APPROXIMATE SOLUTIONS TO TWO-DIMENSIONAL POTENTIAL PROBLEMS OF ELECTROHYDRODYNAMICS. Ushakov, V. V. Fluid Dyn. (USSR) (Engl. Transl.); 7: No. 4, 664-671(1972).

Translated from Izv. Akad. Nauk SSSR, Mekh. Zhidk. Gaza; 7: No. 4, 140-147(1972).

After transformation to new variables the system of equations describing planar potential electrohydrodynamic flows with a small interaction parameter is converted to a single equation. The particular solution of this equation, which is the electrohydrodynamic analog of Hamel's solution in the dynamics of a viscous liquid, is found. Two types of flows, described by simplified equations, can be distinguished when certain constraints are imposed on the manner in which the electrical parameters vary along the coordinate lines and the terms of the equation correspondingly estimated. These flows are the jet and quasi-one-dimensional flows of the charged component in a curvilinear electrostatic field and a superposed two-dimensional potential flow of the carrier medium. Solutions to the approximate equations are obtained for certain particular cases. (auth)

22213 AMPLITUDE-PHASE RELATIONS FOR THE CURRENT AND JOULE DISSIPATION IN A CHANNEL WITH WAVY ELECTRODE. Levin, A. L. Fluid Dyn. (USSR) (Engl. Transl.); 7: No. 2, 361-363(1972).

Translated from Izv. Akad. Nauk SSSR, Mekh. Zhidk. Gaza; 7: No. 2, 185-188(1972).

Amplitude-phase relationships for the current in a channel formed by a plane and slightly varying sinusoidal electrode are examined for the flow of a subsonic or supersonic plane electrically conducting stream therein. Current distributions between the electrodes are presented. The magnitude of the Joulean losses as a function of the Mach number, Hall parameter, and period of the wavy electrode is calculated. The problem considered simulates the flow in magnetogasdynamic channels when there are roughnesses on the electrodes which have been produced or originate specially during combustion of a discharge. (MHR)

22214 WEAK WAVES, CHARACTERISTICS, AND THE PROBLEM OF FLOW ABOUT A THIN PROFILE IN ELECTROHYDRODYNAMICS. Gogosov, V. V.; Polyanskii, V. A. Fluid Dyn. (USSR) (Engl. Transl.); 7: No. 3, 484-492(1972).

Translated from Izv. Akad. Nauk SSSR, Mekh. Zhidk. Gaza; 7: No. 4, 137-146(1972).

The propagation of weak waves in electrohydrodynamics through a medium in an inhomogeneous, unperturbed state is studied. Waves with a wavelength less than the size of the inhomogeneities are considered. The amplitude variation of a wave over distances comparable with a wavelength is neglected. Analyzed in detail is the dispersion equation in the cases when a wave is propagated only by ions while the neutral particles remain at rest, when the flow is isentropic (the mobility coefficient b = 0), and when the mobility coefficient $b \neq 0$. It is shown that in the electrohydrodynamic formulation there exist two phase velocities for the propagation of small perturbations in a medium that is at rest as a whole: $u_0 = \pm a_0$, $u_1 = bE_0$. The phase velocity u_0 is the ordinary sound speed of gas dynamics, and the velocity u_1 coincides with the velocity of the motion of the ion component. In waves propagating with the velocity u_1 there are, generally, fluctuations in the charge density and the electric field, while in waves propagating with the velocity u_0 the gas-dynamic parameters of the medium fluctuate as well. The propagation of high-frequency waves is considered, for which the usual system of electrodydrodynamic equations is inadequate and it is necessary to use the full system of Maxwell equations. The characteristics of the equations of electrohydrodynamics are investigated; a problem on the flow of an electrohydrodynamic stream about a thin profile is discussed. It is shown that for a definite direction and intensity of the electric field the perturbations from the profile can propagate upstream against a supersonic flow. (MHR)

22215 BREAKAWAY SELF-SIMILAR FLOWS IN A LAMINAR MAGNETOHYDRODYNAMIC BOUNDARY LAYER WITH BLOWING AND SUCTION. Gotovtsev, A. V. Fluid Dyn. (USSR) (Engl. Transl.); 7: No. 3, 399-406(1972).

Translated from Izv. Akad. Nauk SSSR, Mekh. Zhidk. Gaza; 7: No. 4, 38-46(1972).

A study was made of self-similar flows in a magnetohydrodynamic boundary layer in the presence of a pressure gradient and with the blowing and suction of a conducting liquid. The region of the existence of self-similar solutions for "breakaway" flow conditions, characterized by a friction at the wall equal to zero, was determined. The regions of a change in the determining parameters, with which nonbreakaway flows are established at impermeable and permeable surfaces, are indicated. It is noted that under diffusion flow conditions the self-similar equation of a magnetohydrodynamic boundary layer with fixed boundary conditions at the wall and at infinity permits an innumerable set of solutions. The article proposes a method for selecting a solution and indicates a calculating method for determining it. It demonstrates the possibility of a considerable broadening of the region of flows without breakaway with the imposition of electric and magnetic fields. (auth)

22216 SELF-SIMILAR NONSTATIONARY MAGNETOHYDRODYNAMIC RADIATING GAS FLOWS CAUSED BY PISTON MOTION. Mareev, V. A. Fluid Dyn. (USSR) (Engl. Transl.); 7: No. 3, 501-506(1972).

Translated from Izv. Akad. Nauk SSSR, Mekh. Zhidk. Gaza; 7: No. 4, 155-160(1972).

Nonstationary magnetohydrodynamic problems are formulated for $R_m \ll 1$ with radiation effects taken into account, and a class of self-similar flows is found corresponding to piston motion according to a power law. The numerical solutions of two self-similar problems are presented, and conditions are found under which accelerations or retardation of the shock front occurs. The results presented confirm the deductions obtained earlier by using linear theory. (MHR)

22217 UNSTEADY PLASMA FLOWS AFTER MOVING FRONT. Mareev, V. A. Izv. Akad. Nauk SSSR, Mekh. Zhidk. Gaza: No. 4, 156-162(Jul 1973). (In Russian).

The unsteady flow of conducting and optically transparent gases, separated from the rarefied stationary medium by the front S, which goes through a zone of an inhomogeneous magnetic field, was examined. Boundary conditions for S were assumed for some mechanisms of the interaction of S with the stationary medium. Solutions were obtained in the linear approximation. By means of numerical methods solutions were found for a general system of equations. The sharply nonmonotonous character of the motion of S in the inhomogeneous magnetic field was established. (tr-auth)

22218 INFLUENCE OF INDUCED MAGNETIC FIELDS ON THE CONVECTIVE STABILITY OF A CURRENT-CARRYING CONDUCTING FLUID. Eismont, O. A. Izv. Akad. Nauk SSSR, Mekh. Zhidk. Gaza; 102-110(1974). (In Russian).

The stability of a plane equilibrium layer of an electrically conducting fluid situated in crossed electric and magnetic fields is analyzed. The influence of an unperturbed and perturbed induced magnetic field on the stability of such a layer is studied. A nonlinear analysis is carried out for the problem of the stability of a plane conducting layer bounded by free ideally conducting surfaces at arbitrary values of the magnetic Prandtl number. (IAA)

22219 MAGNETOHYDRODYNAMIC FLOWS OF THE TYPE OF A "ROLLING WAVE" IN A PERPENDICULAR MAGNETIC FIELD. Vishnyakov, V. I.; Pavlov, K. B. (Higher Technical School, Moscow). Fluid Dyn. (USSR) (Engl. Transl.); 7: No. 1, 147-152 (1972).

Translated from Izv. Akad. Nauk SSSR. Mekh. Zhid. Gaza; 7: No. 1, 162-168(1972).

The motion of two interacting viscous media with arbitrary conductivity in an inclined channel with nonconducting walls, located in a transverse magnetic field, is considered. An asymptotic method was used in the solution; using this method, fully established flow is described with a wavy interface between the media. Dependences are obtained for the form of the wave and its length on the determining parameters of the problem; for some of these, numerical calculations are carried through. (MHR)

22220 INTEGRATION OF THE MAGNETOHYDRODYNAMIC BOUNDARY-LAYER EQUATIONS BY MEKSYN'S METHOD. Liron, N. (Weizmann Inst. of Science, Rehovot, Israel); Wilhelm, H. E. Z. Angew. Math. Mech.; 54: 27-37(Jan 1974).

The nonlinear boundary-value problem describing the spatial development of the boundary layer in a conducting fluid flowing transverse to an inhomogeneous magnetic field along a flat plate with external pressure gradient is formulated. Analytical solutions of the velocity field are obtained for both unseparated and separated points in the MHD flow by means of transformations, series expansions, and integration procedures (method of steepest descent) introduced by Meksyn in the analysis of ordinary boundary layers. In an application, attention is given to MHD diffuser flows. It is shown that an inhomogeneous magnetic field can suppress boundary-layer separation. (auth)

22221 THEORETICAL AND APPLIED MECHANICS. Proceedings of the Thirteenth International Congress, Moscow, USSR, August 21-26, 1972. Becker, E.; Mikhailov, G. K. (eds.). Berlin; Springer-Verlag (1973). 374p. (CONF-720848-). $46.20.

From 13th international congress of theoretical and applied mechanics; Moscow, USSR (Aug 1972).

Twenty-two lectures on solid and fluid mechanics are included. A separate abstract was prepared for one on electrohydrodynamics. (MHR)

For an abstract of an individual lecture see: 22222.

22222 ELECTROHYDRODYNAMICS. Melcher, J. R. (Cambridge Univ., Eng.). pp 240-263 of Theoretical and Applied Mechanics. Becker, E. (Ed.). Berlin; Springer-Verlag (1973).

From 13th international congress of theoretical and applied mechanics; Moscow, USSR (Aug 1972). See CONF-720848-.

The electromechanical coupling between electric fields and fluids is discussed. A few macroscopic models are introduced and used for reviewing a wide range of phenomena. Interactions, classified after terminology was established, are discussed at length. The sole concern is with electro-quasi-static phenomena, where processes connected with the propagation time of electromagnetic waves are complete in times short compared to those of interest, and electric dominates magnetic energy storage. (MHR)

22223 MAGNETOHYDRODYNAMIC FLOW PAST A FINITE FLAT PLATE IN THE PRESENCE OF A NONALIGNED MAGNETIC FIELD. Lakin, W. D. (Univ. of Toronto). Can. J. Phys.; 52: No. 12, 1104-1106(15 Jan 1974).

Steady flow past a finite flat plate due to a uniform stream is considered in the presence of a uniform magnetic field which is not aligned with the streaming motion at infinity. The Hartmann is assumed large and positive. This leads to a singular perturbation problem involving a second-order partial differential equation. As a result, solutions of the governing equation must be obtained in three separate regions and then matched asymptotically. A related problem involving magnetohydrodynamic (MHD) flow across a finite needle is also discussed. (auth)

22224 NUMERICAL EXPERIMENT RELATING TO THE DETACHMENT OF THE LAMINAR BOUNDARY LAYER IN A MAGNETOHYDRODYNAMICAL (MHD) CHANNEL. Alferov, V. I.; Dmitriev, L. M.; Dudin, G. N. High Temp. (USSR) (Engl. Transl.); 11: No. 3, 507-512(1973).

Translated from Teplofiz. Vys. Temp.; 11: No. 3, 568-574(1973).

The results of a calculation of the laminar boundary layer in the electrode wall of an MHD channel are presented. It is shown that the concentration of the currents at the electrodes of a segmented MHD channel may lead to the detachment of the boundary layer; detachment occurs in the zone of maximum current. The detachment coordinate depends very substantially on the current density in the zone of current concentration. (auth)

PHYSICS (HIGH-ENERGY)

Particle Interactions and Properties (Experimental)

Refer also to abstracts 22315–22317.

22225 (RL-74-41) WORK OF THE RUTHERFORD LABORATORY IN 1973. Smith, J. R.; Telling, F. M. (eds.). (Science Research Council, Chilton (UK). Rutherford Lab.). May 1974. 201p. Dep. NTIS (US Sales Only) $13.25.

This report is basically administrative in nature, although some data are given. It is divided into the following chapters and sections: High-energy physics (experiments using electronic techniques, bubble chamber experiments, nuclear structure experiments, radiological experiments, EPIC physics and machine studies, theoretical high-energy physics), Accelerator operations and development (operation of Nimrod, accelerator development, beam lines and associated equipment), Instrumentation and data handling (1.5-meter hydrogen bubble chamber, instrumentation for counter experiments, electronics instrumentation, data handling for experiments), Applied research (studies in applied superconductivity, rapid cycling bubble chamber development, polarized target development, computer-aided design of magnets, experiments mounted on space satellites), Neutron beam research (techniques and instruments, support of the research program), Computing services (central computer operation, operating system developments, film analysis and software for data analysis), and Technical services and administration (radiation protection and general safety, support services, administration). A 32-page list of publications and lectures and a drawing of beam lines in the experimental halls are also included. Six of the papers are separately title listed. (106 figures) (RWR)

For title listings of individual papers see: 22246 and 22278–22282.

22226 PROCEEDINGS OF THE TRIANGLE SEMINAR, VIENNA, AUSTRIA, OCTOBER 9–10, 1972. Haberler, P. L. F.; Pietschmann, H. (eds.). Vienna; Institut fuer Hochenergiephysik, Oesterreichische Akademie der Wissenschaften (1972). 110p. (CONF-7210121–).

The conference contained 11 papers. Separate abstracts for each paper. (JFP)

For abstracts of individual papers see: 21249, 21250, 21938, 22256, 22295–22300, and 22389.

22227 INVARIANT EFFECTS IN BACKWARD EMISSION OF p, d, t BY NUCLEI BOMBARDED BY 0.7 TO 6 GeV ELEMENTARY PARTICLES. Bayukov, Yu. D.; Vorob'ev, L. S.; Leksin, G. A.; Novikov, L. S.; Stolin, V. L.; Fedorov, V. B.; Khovanskii, V. D.; Shishov, N. N. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 19: No. 6, 1266–1269(Jun 1974). (In Russian).

It is found that the function $f(p^2)/\sigma_{tot}$ describing the spectra of protons and deuterons leaving the nuclei in the backward (in the laboratory system) direction is universal, i.e. does not depend on the energy and type of the ingoing particle and on the atomic number of the target nucleus. (auth)

Electromagnetic

Refer also to abstracts 22180, 22342, and 22597.

22228 (DESY-74/11) PHOTOPRODUCTION OF RHO-ZERO, ω AND RHO-MINUS MESONS ON DEUTERONS AT ENERGIES BETWEEN 1 AND 5 GeV. Benz, P.; Butenschoen, H.; Gall, D.; Knies, G.; Braun, O.; Idschok, U.; Mueller, K.; Nellen, B.; Kiesling, C.; Schiffer, R. (Deutsches Elektronen-Synchrotron (DESY), Hamburg, (F. R. Germany)). Mar 1974. 24p. INIS.

15 figs.; 2 tabs.; 48 refs. With abstract.

The reactions $\gamma d \to \rho^0 d$, $\gamma d \to \omega d$ and $\gamma n \to \rho^- p$ have been investigated in a deuterium bubble chamber experiment at DESY with a bremsstrahlung beam of 5.5 GeV maximum energy. Effective mass distributions as well as total and differential cross sections are presented. The results are compared with ρ^0 and ω production of protons. (auth)

22229 (JINR-E1-8047) PION RADIUS. Adylov, G.; Aliev, F.; Bardin, D.; Gajewski, W.; Ioan, I.; Kulakov, V.; Micelmacher, G.; Niczyporuk, B.; Nigmanov, T.; Tsyganov, E.; Turala, M.; Vodopianov, A.; Wala, K.; Dally, E.; Drickey, D.; Liberman, A.; Shepard, P.; Tompkins, J.; Buchanan, C.; Poirer, J. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1974. 20p. (CONF-740713-11). Dep. NTIS (US Sales Only) $4.00.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

The pion radius has been measured by direct scattering of 50 GeV negative pions from stationary electrons in a hydrogen target. We find the square of the radius to be $\langle r_\pi^2 \rangle = (0.61 \pm 0.15)$ F^2. (auth)

22230 (KHFTI-72-45, pp 35-36) PHOTOPRODUCTION OF CHARGED PIONS ON NUCLEI AT THE BREMSSTRAHLUNG MAXIMUM ENERGY 1000 MeV. Grishaev, I. A.; Krinitsyn, A. N.; Lapin, N. I.; Nikiforov, V. I.; Pugachev, G. D.; Shramenko, B. I. 1972. (In Russian).

The results of the measurement of the photoproduction of charged pions at a maximum bremsstrahlung energy of 1000 MeV are reported. The dependence of the mean free path of the pions in the nuclear material as a function of the kinetic energy of the pions and the yield of the positive and negative pions on the nucleons as a function of the mass number of the nucleus and the angle of flight are shown. The data obtained were compared with data calculated in the impulse approximation with consideration of the interaction in the final state according to the optical model. (tr-auth)

22231 CURRENT STATUS OF THE PARTICLE DATA GROUP S2 TAPE PROJECT. Kelly, R. L. (California Univ., Berkeley). pp 81-83 of Baryon Resonances, 73. West Lafayette, IN; Purdue Univ. (1973).

From conference on baryon resonances; West Lafayette, Indiana, USA (20 Apr 1973). See CONF-730477-.

Cross checking of the external tapes, which represent the most complete available collections of data on single pion photoproduction below 1.5 GeV and on πN elastic and charge-exchange scattering, respectively, is underway. A brief description is given of the system that was developed to produce the πN S2 tape. A table is presented showing the current holdings of the PDG external tape library. (JFP)

22232 SYNCHROTRON RADIATION: LIGHT FANTASTIC. Perlman, M. L. (Brookhaven National Lab., Upton, NY); Rowe, E. M.; Watson, R. E. Phys. Today; 27: No. 7, 30-37(Jul 1974).

The discussion of synchrotron radiation covers applications to photochemistry, solids and their surfaces, photon scattering in nonlinear optics, structure, other applications, and future research. (JFP)

22233 DEEPLY INELASTIC PRODUCTION OF HADRONS ASSOCIATED BY A MUON PAIR IN COLLIDING ELECTRON–POSITRON BEAMS. Choban, E. A. (Leningrad Polytechnic Inst.). Yadern. Fiz.; 19: No. 6, 1313-1321(Jun 1974). (In Russian).

The electron-positron annihilation into the $\mu^-\mu^+$ pair and arbitrary number of hadrons is considered. The differential cross section of production of an even charge-parity hadron system in the deeply inelastic region is expressed through the probabilities of transformation of a virtual photon to a virtual photon and hadrons. Those probabilities are calculated in the parton model. The differential cross section of production of an odd-charge-parity hadron system in the deeply inelastic region is found for the case when the total mass of hadrons and the final photon mass in the above mentioned transformation are considerably lower than the initial photon mass. The differential cross sections for $C = +1$ and $C = -1$ are estimated in the deeply inelastic region. (auth)

22234 ANGULAR DISTRIBUTION OF THE ASYMMETRY OF THE CROSS SECTION OF THE REACTION $\gamma n \to \pi^- p$ WITH LINEARLY POLARIZED PHOTONS. Ganenko, V. B.; Gorbenko, V. G.; Zhebrovskii, Yu. V. (Physical-Technical Inst., Kharkov). Yadern. Fiz.; 19: No. 6, 1245-1246(Jun 1974). (In Russian).

New systematic measurements were made of angular distributions of the asymmetry of the cross section of the reaction $\gamma n \to \pi^- p$ in the linearly polarized photon beam of 250 to 500 MeV energy in the angular range from 30 to 140° in the c.m.s. The results are compared with predictions of various models. (auth)

Weak

22235 (ANL/HEP-7436) EXCLUSIVE NEUTRAL CURRENT REACTIONS. Schreiner, P. A. (Argonne National Lab., Ill. (USA)). 1974. 30p. (CONF-740713-13). Dep. NTIS $4.50.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

A review is given of the recent experimental results on the following exclusive neutral current processes: $\nu p \to \nu n\pi^+$, $\nu p \to \nu p\pi^0$, $\nu p \to \nu p$, and $\nu n \to \nu p\pi^-$. It is concluded that while the data establish that neutral currents do exist, much better quality data on the

properties of the exclusive channels are clearly needed to seriously test the current models. (LBS)

22236 FORM FACTORS IN THE $K^0_{\mu 3}$ DECAY. Berlin-Budapest-Dubna-Prague-Sofia-Serpukhov Collaboration. Yadern. Fiz.; 19: No. 6, 1247-1253(Jun 1974). (In Russian).

The 82386 selected $K^0_{\mu 3}$ decays observed in the Serpukhov experiment with neutral kaons are analyzed. There are found two solutions for the vector and scalar form factors. For both solutions the linear approximation is shown to be valid. Both solutions can be compared with the results of already published papers. The solution which is in better agreement with the $\mu - e$ universality hypothesis gives the following values for the parameters of the linear expansion: $\lambda_+ = 0.046 \pm 0.008$, $\lambda_- = 0.024 \pm 0.011$. (auth)

22237 DETAILED BALANCE IN PION PHOTOPRODUCTION IN THE FIRST RESONANCE REGION. Joseph, C. (CERN, Geneva). pp 33-40 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973). See CONF-730642-.

Experimental results in photoproduction of negative pions and radiative capture of π^- by protons are reviewed in the context of the existence of an isotensor component of the electromagnetic current of hadrons and of time reversal invariance. (auth)

Strong (Baryon-induced)

Refer also to abstracts 22395, 22408, 22594, 22595, 22601, 22649, and 22766.

22238 (ANL/HEP-7427) STUDY OF THE REACTION $p + p \rightarrow \Delta^{++} + X^0$ AT 205 GeV/c. Barish, S.; Derrick, M.; Musgrave, B.; Schultz, P.; Whitmore, J.; Engelmann, R.; Kafka, T.; Pratap, M. (Argonne National Lab., Ill. (USA)). 1974. 20p. (CONF-740713-12). Dep. NTIS $4.00.

From 14th international conference on high-energy physics; London, UK (1 Jul 1974).

Inclusive Δ^{++} production was studied for $|t_{p\Delta}| < 1.0$ $(GeV/c)^2$ in a 50,000 picture exposure of the 30-inch hydrogen bubble chamber to a 205 GeV/c proton beam. The inclusive Δ^{++} cross section is, for both CM hemipsheres, 2.60 ± 0.34 mb. The distribution of the missing mass of the system recoiling off the Δ^{++} is compared to that observed in the inelastic reaction $p + p \rightarrow p +$ anything, and its charged multiplicity is also presented. The connection between Δ^{++} and diffraction is discussed. It is found that not all Δ^{++} come from the decay of a diffractively-produced state. The P^2_T distribution for the Δ^{++} has a slope of (10.8 ± 1.6) GeV/c^{-2} for $P^2_T \lesssim 0.2$ GeV/c^3. This slope, together with the decay angular distributions of the Δ^{++} at small t', suggests a pion exchange contribution to the inclusive process. The data are compared to the expectation of a Triple Regge Model with a dominant $\pi\pi P$ coupling. (auth)

22239 (COO-1112-201) RECENT RESULTS FROM THE NAL BUBBLE CHAMBER. Vander Velde, J. C. (Michigan Univ., Ann Arbor (USA)). 1973. Contract AT(11-1)-1112. 12p. (CONF-730841-5). Dep. NTIS $4.00.

From 5th international conference on high energy collisions; Stony Brook, New York, USA (23 Aug 1973).

A summary is presented of the results obtained during the last few months from the 30-inch hydrogen bubble chamber at National Accelerator Laboratory. The broad topics covered are: slow proton spectra (diffractive production; total cross sections, elastic cross sections, and multiplicity; production of neutrals; charge transfer and correlations. (LBS)

22240 (COO-1112-217) MEASUREMENT OF PROTON-PROTON SCATTERING WITH A POLARIZED BEAM AND A POLARIZED TARGET. Roberts, J. B. (Michigan Univ., Ann Arbor (USA). Randall Lab. of Physics). Dep. NTIS $4.00.

From symposium on high energy physics with polarized beams; Argonne, Illinois, USA (8 Feb 1974).

The measurement of the elastic and total cross sections in pure transverse initial spin states is described. The experimental details are presented. (LBS)

22241 (COO-2009-67) HIGHLIGHTS OF THE INDIANA UNIVERSITY SPARK CHAMBER PROGRAM IN 1973. Brabson, B. B.; Crittenden, R. R.; Heinz, R. M.; Neal, H. A. (Indiana Univ., Bloomington (USA). Dept. of Physics). 1973. Contract AT(11-1)-2009. 4p. Dep. NTIS $4.00.

Experimental research on $p + p$ interactions, proton structure, and a search for exotic mesons is summarized. (JFP)

22242 (COO-2232A-5) EXCITATION OF THE PROTON TO LOW MASS STATES AT 180 AND 270 GeV. Akimov, Y.; Golovanov, L.; Mukhin, S. (Rochester Univ., N. Y. (USA)). 1974. 20p. (CONF-740713-21; COO-306588; UR-495). Dep. NTIS $4.00.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

The gas jet target in the internal beam of the FERMILAB accelerator was used with the provision of a special slit in order to improve the resolution of the measurement of the angle of the recoil target particle in the reaction $p + d \rightarrow N^* + d$. This results in an improvement of the mass resolution so that it is possible to separate the $N^*(1400)$ and $N^*(1690)$ mass regions from the proton-deuteron elastic peak up to incident proton energies of 270 GeV. It is observed that the excitation cross section is independent of incident energy whereas the t dependence is a strong function of the mass. Furthermore, the data agree with the corresponding reaction $p + p \rightarrow N^* + p$ when the deuteron form factor is taken into account. (8 figures) (auth)

22243 (JINR-E1-8054) EXPERIMENTAL INVESTIGATION OF CUMULATIVE MESON PRODUCTION. Baldin, A. M.; Ghiordanescu, N.; Ivanova, L. K.; Moroz, N. S.; Povtoreiko, A. A.; Radomanov, V. B.; Stavinskii, V. S.; Zubarev, V. N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1974. 27p. (In Russian). Dep. NTIS (US Sales Only) $4.50.

The energy spectra of mesons, produced on nuclei D, C, Al, Cu, Pb by 6 and 8.4 GeV/c protons at an angle of 180°, have been measured. It is shown that in the antilaboratory system these reactions correspond to the processes of the interaction of relativistic nuclei with protons. As a result, the produced mesons take the energy much higher than that per one nucleon of a relativistic nucleus. The observed cumulative effect to the 4th order inclusive is described by simple regularities. (auth)

22244 (KHFTI-73-9, pp 20-24) DIFFERENTIAL CROSS SECTIONS OF SCATTERING OF PROTONS WITH 1 GeV ENERGY BY ^{12}C NUCLEI IN THE ANGULAR INTERVAL $\theta_{cm} = 10$ TO 30°. Alkhazov, G. D.; Amal'skii, G. M.; Belostotskii, S. L.; Vorob'ev, A. A.; Domchenkov, O. A.; Dotsenko, Yu. V.; Starodubskii, V. E. (Inst. of Nuclear Physics, Leningrad). 1973. (In Russian).

The results of the measurement of the differential cross section for the elastic and inelastic scattering of protons at 1 GeV on ^{12}C nuclei in the interval of angles $\Theta_{cms} = 10$ to 30° were reported. The calculations of the cross sections and the form factors were made in the framework of the Glauber model with use of different wave functions for ^{12}C. The results were compared with calculations made by the oscillator model and the deformed nucleus model. (tr-auth)

22245 (LBL-3030) EXPERIMENTAL STUDY OF $\bar{p}n$ ANNIHILATION CROSS SECTIONS IN $\bar{p}d$ INTERACTIONS BETWEEN 1.0 AND 1.6 GeV/c. Huesman, R. H. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 25 Apr 1974. Contract W-7405-eng-48. 83p. Dep. NTIS $7.25.

Thesis.

A systematic study of $\bar{p}n$ annihilations into three or more pions was performed in the region of the enhancement in the $I = 1$, $\bar{N}N$ total cross section at 2190 MeV. Cross sections are reported for the final states $\pi^+2\pi^-$, $\pi^+2\pi^-\pi^0$, $\pi^+2\pi^-$(mm $\geq 2\pi^0$), $2\pi^+3\pi^-$, $2\pi^+3\pi^-\pi^0$, and $2\pi^+3\pi^-$(mm $\geq 2\pi^0$). Assuming the enhancement is due to a resonance, a simple model is used to estimate the amount of resonance present in each final state. The fits result in some resonance in all final states, and at the 95% confidence level, non-zero lower limits exist for the final states in $\pi^+2\pi^-$, $\pi^+2\pi^-\pi^0$, and $2\pi^+3\pi^-$. (auth)

22246 (RL-74-41, pp 50-52) NEUTRON-PROTON INTERACTIONS BELOW 3.5 GeV/c. May 1974.

22247 SU(6) 20-PLET. Yaffe, D.; Chaloupka, V.; Ferrando, A.; Losty, M.; Montanet, L.; Paul, E.; Zieminski, A. (CERN, Geneva). pp 85-92 of Baryon Resonances, 73. West Lafayette, IN; Purdue Univ. (1973).

From conference on baryon resonances; West Lafayette, Indiana, USA (20 Apr 1973). See CONF-730477-.

Preliminary evidence is presented for a narrow $I = \frac{1}{2}$ N^* resonance at a mass of 1900 MeV which decays into $p\pi^-\pi^+$ via the $N^0(1530)\pi^+$ intermediate state but not via $\Delta^{2+}(1236)\pi^-$ or $\Delta^0(1236)\pi^+$ and probably not via the $p\rho^0$ channel. (auth)

22248 REACTION $\pi^-p \rightarrow \eta^0 n$ UP TO $p^*_\pi = 400$ MeV/c: EXPERIMENTAL RESULTS AND PARTIAL WAVE ANALYSIS. Lemoigne, Y.; Granet, P.; Marty, P.; Ayed, R.; Bareyre, P.; Borgeaud, P.; David, M.; Ernwein, J.; Feltesse, J.; Villet, G. (CEN-Saclay, France). pp 93-96 of Baryon Resonances, 73. West Lafayette, IN; Purdue Univ. (1973).

From conference on baryon resonances; West Lafayette, Indiana, USA (20 Apr 1973). See CONF-730477-.

An accurate measurement of $d\sigma/d\Omega$ ($\pi^-p \rightarrow \eta n$) at 1531 MeV total energy (expanded up to $l = 4$ Legendre polynomials) requires re-

consideration of previous angular distribution fits which were expanded only up to l = 2 and of subsequent partial wave analysis. An energy dependent partial wave analysis was performed for p_η^* up to 400 MeV/c. The analysis uses the S_{11} (1523 MeV) and the new P_{11} (1530 MeV) resonances observed in the 1972 Saclay phase shift analysis. The D_{13} (1528) resonance is also required; the sign and the absolute value of its amplitude are found to be in agreement with recent SU_3 predictions. (auth)

22249 NOVEL TECHNIQUE TO STUDY DIFFRACTIVE BARYON RESONANCES. Anderson, E. W. (Brookhaven National Lab., Upton, NY); Erwin, A. R.; Fisher, G. P. pp 97-102 of Baryon Resonances, 73. West Lafayette, IN; Purdue Univ. (1973).

From conference on baryon resonances; West Lafayette, Indiana, USA (20 Apr 1973). See CONF-730477-.

The practical feasibility of studying diffractive N* production with automatic spark chamber techniques is demonstrated by finding the missing mass distributions for multiple production in p + p interactions at 28.5 GeV/c. (JFP)

22250 Σ^--NUCLEUS INTERACTIONS AT 25 GeV/c: PRODUCTION OF $\Lambda\pi$. Wang, C. (Brookhaven National Lab., Upton, NY); Atac, M.; Ecklund, S. pp 239-246 of Baryon Resonances, 73. West Lafayette, IN; Purdue Univ. (1973).

From conference on baryon resonances; West Lafayette, Indiana USA (20 Apr 1973). See CONF-730477-.

The reactions of 25 GeV/c Σ^- on a scintillator target were studied with the Brookhaven A.G.S. negative hyperon beam, in a 1.2 million trigger counter-spark chamber experiment. Both the directions and momenta of the incident Σ^- and of the outgoing charged particles were measured. Over a part of the momentum range, a threshold Cherenkov counter distinguished final state pions from kaons. A total absorption calorimeter identified the fast forward proton from the Λ decay. Preliminary results on a fraction of the data are presented. (auth)

22251 CHANGING $\Sigma(1600)$ BRANCHING RATIO. Eberhard, P. H. (California Univ., Berkeley). pp 247-252 of Baryon Resonances, 73. West Lafayette, IN; Purdue Univ. (1973).

From conference on baryon resonances; West Lafayette, Indiana, USA (20 Apr 1973). See CONF-730477-.

Three new experimental results were reported about the branching ratio $\Sigma\pi\pi/\Sigma\pi$ of the $\Sigma(1660)$ resonance produced in K^-p production experiments. One of them contradicts, and the two others corroborate statements published years ago, according to which this branching ratio changes with production angle. Overwhelming evidence is still in favor of the changing branching ratio, which can be simply explained by the existence of two $\Sigma(1660)$ with different branching ratios and different production distributions. (auth)

22252 CASCADE RESONANCES FROM DUKE TO PURDUE. Moneti, G. C. (Syracuse Univ., NY). pp 335-343 of Baryon Resonances, 73. West Lafayette, IN; Purdue Univ. (1973).

From conference on baryon resonances; West Lafayette, Indiana, USA (20 Apr 1973). See CONF-730477-.

Experimental and theoretical research on cascade resonances is reviewed. It is noted that there has been no breakthrough and progress is minor. (JFP)

22253 PRODUCTION OF STRANGENESS -2 BARYONS IN THE MASS REGION 1600 TO 2100 MeV/c^2 IN K^-p INTERACTIONS AT 3.1, 3.3, AND 3.6 GeV/c. Ross, R. T.; Lloyd, J. L.; Radojicic, D. (Oxford Univ.). pp 345-353 of Baryon Resonances, 73. West Lafayette, IN; Purdue Univ. (1973).

From conference on baryon resonances; West Lafayette, Indiana, USA (20 Apr 1973). See CONF-730477-.

Experimental results on the mass, width, decay, production process, and yield are given for the $\Xi(1610)$, $\Xi(1820)$, $\Xi(1950)$, and $\Xi(2030)$ resonances. The confusion in the region of the $\Xi(1820)$ suggests that there may be more than one state there. The state $\Xi(1950)$ is well established in the $\Xi\pi$ decay modes. (JFP)

22254 XI(1530) RESONANCE IN K^-p REACTIONS AT 3.1 TO 3.6 GeV/c. Ross, R. T.; Lloyd, J. L.; Radojicic, D. (Oxford Univ.). pp 355-361 of Baryon Resonances, 73. West Lafayette, IN; Purdue Univ. (1973).

From conference on baryon resonances; West Lafayette, Indiana, USA (20 Apr 1973). See CONF-730477-.

The mass, width, and differential cross section measurements are presented for $\Xi(1530)$ production in K^- + p interactions at 3.13 to 3.58 GeV/c in a bubble chamber. (JFP)

22255 CASCADE RESONANCE (NON-) PRODUCTION IN K^-d INTERACTIONS AT 2.9 GeV/c. Schmidt, P. E. (Brandeis Univ., Waltham, MA). pp 363-381 of Baryon Resonances, 73. West Lafayette, IN; Purdue Univ. (1973).

From conference on baryon resonances; West Lafayette, Indiana, USA (20 Apr 1973). See CONF-730477-.

In K^-d interactions at 2.9 GeV/c, an upper limit of 2.4 μb is placed on the production of exotic cascade resonances. Previously observed Ξ resonances with mass less than 2 GeV decaying into $\Xi\pi$ are shown to have isospin $\frac{1}{2}$ by their absence in the final state $\Xi^-\pi^-K^+$. The reaction $K^-p \to \Xi^-\pi^+K^0$ again shows evidence of $\Xi(1630)$ in agreement with a previous experiment in hydrogen. (auth)

22256 SINGLE AND DOUBLE PHOTON PRODUCTION AND ITS CORRELATION TO CHARGED PRODUCTION IN PP COLLISIONS AT THE ISR. Cottfried, C. pp 34-46 of Proceedings of the Triangle Seminar. Haberler, P. L. F. (ed.). Vienna; Institut fuer Hochenergiephysik, Oesterreichische Akademie der Wissenschaften (1972).

From Triangle seminar on experimental high energy physics; Vienna, Austria (9 Oct 1972). See CONF-7210121-.

From the study of correlations in processes like $pp \to \gamma$ + charge + anything and $pp \to 2\gamma$ + charge + anything it is concluded that that data on inclusive single events indicate that Feynman scaling is not yet reached at ISR energies in the region around 90°. There exist correlations in double photon events and between charged particles and photons, which will be studied in more detail in order to decide between different models for particle production. (JFP)

22257 CHARACTERISTICS OF PARTICLE SPECTRA PRODUCED IN p-p INTERACTIONS AT 28.5 GeV/c. Gilbert, D. R. Blacksburg, VA; Virginia Polytechnic Institute (1974). 65p. University Microfilms Order No. 74-14,490.

Thesis (Ph.D.).

Using a new and unique multiparticle spectrometer system, data were taken on proton-proton collisions at 28.5 GeV/c. The analysis of 25,000 4-prong and 19,000 6-prong final states undertaken to determine the dependence of the transverse momentum spectra of produced particles on the fast, detected final state proton, is reported. It is found that the transverse momentum distribution of the secondaries is independent of both the four-momentum transfer to the proton and the proton's transverse momentum, except at low values for both where resonance production limits the transverse momentum of some secondaries. A slight dependence of the transverse momentum distribution on the mass recoiling against the fast proton which is related to the linear rise of multiplicity with increasing mass is observed. (Diss. Abstr. Int., B)

22258 MULTIPARTICLE EVENTS WITH IDENTIFIED FINAL STATE PROTONS RESULTING FROM pp INTERACTIONS AT 28.5 GeV/c. Stringfellow, B. C. Blacksburg, VA; Virginia Polytechnic Inst. and State Univ. (1973). 88p. University Microfilms Order No. 74-14,506.

Thesis (Ph.D.).

Using a new and unique multiparticle detection device, the average final state multiplicity was measured for a sample of 1,500 events from the reaction $pp \to pp(n\pi^4)$ at 28.5 GeV/c where both protons were constrained to limited regions of phase space. It is found that the resulting average charge multiplicity depends linearly on the recoil mass from both protons, and on the inelasticity. A rapidity analysis indicates that low multiplicity final states are produced by one fragmenting proton, while as the multiplicity increases, so does the probability of the other proton also fragmenting. No evidence was found for multiperipheral production. The data are compared with events in which only one proton is constrained and it is found that the multiplicity varies with the behavior of both final state protons, the higher multiplicities occurring for more central collisions. (Diss. Abstr. Int., B)

22259 EXPERIMENTAL CHARGE MULTIPLICITY DISTRIBUTION IN PROTON-PROTON INTERACTIONS AT 28.5 GeV/c. Schreiner, W. N. Blacksburg, VA; Virginia Polytechnic Institute (1974). 57p. University Microfilms Order No. 74-14,502.

Thesis (Ph.D.).

The average charge multiplicity in the reaction $pp \to pX$ at 28.5 GeV/c was experimentally determined as a function of the two independent variables relating to the detected fast out-going proton. The data show a sharp increase with the recoil mass, W, a linear rise with the four-momentum transfer, t, for constant W and a slight rise as a function of the transverse momentum, P_T, for constant W out to the limits of our data sample. An adequate representation of the data was found to be given by $\bar{N}(t,W) = 2 + 1.2$ (W-m) + (0.011t-0.11) $(W-m)^2$ where m is the proton mass. By integrating over one of the independent variables the charge multiplicity was found to be nearly linear in W, linear in t for $t > 2$ $(GeV/c)^2$ and linear in P_T for $P_T < 1.3$ GeV/c. (Diss. Abstr. Int., B)

22260 ANTIPROTON-PROTON ANNIHILATION INTO $\pi^+\pi^-$, K^+K^-, and $K^0\bar{K}^0$ AT INCIDENT LABORATORY MOMENTUM OF 250 TO 800 MeV/c. Rutz, R. L. Madison, WI; University of

Wisconsin (1973). 167p. University Microfilms Order No. 74-9201.

Thesis (Ph.D.).

From a total of about 225,000 pictures of $\bar{p}p$ interactions at laboratory momenta between 250 and 800 MeV/c in the Brookhaven National Laboratory 30 in. hydrogen bubble chamber, the reactions were studied: (1) $\bar{p}p \rightarrow \pi^+\pi^-$, (2) $\bar{p}p \rightarrow K^+K^-$, (3a) $\bar{p}p \rightarrow K^0\bar{K}^0 \rightarrow K_S^0K_S^0$, and (3b) $\bar{p}p \rightarrow K^0\bar{K}^0 \rightarrow K_S^0K_L^0$. The angular distribution for the first reaction smoothly shifts from a distribution with a predominantly forward going π^- to a symmetric distribution as the beam momentum is increased over the range studied. No resonant states are indicated for Reaction 1 in the cross section for that annihilation process. In contrast, the Reactions 2 and 3b show enhancements in their respective cross sections, although the angular distributions are relatively constant over the beam momentum interval covered. For the K^+K^- annihilation mode, the enhancement suggests a resonance at a mass of about 1935 MeV and spin as high as J = 4, while an enhancement in the $K_S^0K_L^0$ cross section appears at a value near 1965 MeV. The spin of this resonance seems lower, perhaps J = 1, although the large statistical error precludes a definite determination of the spin. Only one event of the type $K_S^0K_S^0$ was observed. The cross sections for the several processes $\bar{p}p \rightarrow K_S + K_S$ + MM (Missing Mass) and $\bar{p}p \rightarrow K_S + L_L$ + MM were also measured, and show no significant structure. The results are discussed in their relation to some current ideas concerning antiproton–proton annihilation and heavy meson spectroscopy. (Diss. Abstr. Int., B)

22261 POLARIZATION IN PROTON–PROTON SCATTERING AT 5.15, 7.0, AND 12.33 GeV/c. Abshire, G. W. Bloomington, IN; Indiana University (1974). 105p. University Microfilms Order No. 74-14,164.

Thesis (Ph.D.).

The results of an experiment to measure the polarization in large angle proton–proton elastic scattering are presented. This experiment, performed at Argonne National Laboratory, represents the first high statistics proton–proton polarization measurements for $|t|$ values greater than 2.5 $(GeV/c)^2$. The t range examined at 5.15 GeV/c was 0.54 $(GeV/c)^2 \leq |t| \leq 4.03$ $(GeV/c)^2$; for 7.0 GeV/c we examined 0.58 $(GeV/c)^2 \leq |t| \leq 5.25$ $(GeV/c)^2$; the t range, 1.53 $(GeV/c)^2 \leq |t| \leq 6.19$ $(GeV/c)^2$, was covered for 12.33 GeV/c. The results are discussed in terms of four models. Two of these are optical models; one was proposed by Durand and Lipes, the other by Chu and Hendry. The other two models are the Regge pole model and the parton model. Fits to the data were done using the first three models; the optical model of Chu and Hendry best described the structure in the data. (LBS)

22262 pn INTERACTIONS IN 2-m DEUTERIUM CHAMBER. Takibaev, Zh. S.; Boos, E. G.; Zhautykov, B. O.; Mosienko, A. M.; Tursunov, R. A. (Inst. of High Energy Physics, Alma Ata, USSR). Yadern. Fiz.; 19: No. 6, 1254-1261(Jun 1974). (In Russian).

Results are presented of analysis of 1132 inelastic pn interactions detected in the 2-m bubble chamber at CERN, exposed to the proton beam with the momentum of 19.2 GeV/c. The momentum and angular distributions of the secondary particles, mean numbers of pions, kaons and protons per an interaction event are presented, the part of the initial energy emitted by the secondary charged pions in the c.m.s. of colliding nucleons is estimated. Distribution of protons emitted into forward and backward hemispheres (c.m.s.) in the four-momentum transfer is given. Comparison of some properties of the pp and pn interactions is carried out. (auth)

22263 $d\sigma(0^0)/d\Omega, \sigma_{tot\ el}$ AND $ReA(0^0)$ FOR ELASTIC pp SCATTERING IN THE 1 TO 1000 MeV ENERGY RANGE. Amirkhanov, I. V.; Zul'karneev, R. Ya.; Murtazaev, H.; Nadejdin, V. S.; Satarov, V. I. (Joint Inst. for Nuclear Research, Dubna, USSR). pp 47-50 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973). See CONF-730642-.

The cross-sections of elastic pp-scattering in the region of Coulomb-nuclear interference at 100, 500, 600, 630, and 670 MeV have been measured. On the basis of these experimental results and those obtained by other scientists the values of $ReA(0^0)$ and of $\sigma_{tot\ el}$ have been determined in the energy region from 1 to 1000 MeV. The energy dependence of $ReA(0^0)$ has been discussed from the point of view of dispersion relations. (auth)

22264 COMPLETE DIFFERENTIAL CROSS SECTIONS FOR THE REACTION $pp \rightarrow d\pi^+$ FROM 3.0 TO 5.0 GeV/c. Anderson, H. L. (Univ. of Chicago); Larson, D.; Myrianthopoulos, L.; Dubal, L.; Hargrove, C. K.; Hincks, E. P.; McKee, R. J.; Mes, H.; Kessler, D.; Thompson, A. C. pp 205-208 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973). See CONF-730642-.

Complete differential cross section measurements for the reaction $pp \rightarrow d\pi^+$ have been carried out at eight values of incident proton momentum from 3.0 to 5.0 GeV/c. These measurements exhibit a strong dependence on momentum transfer and energy and show that the previously observed enhancement in the forward cross section due to the $\Delta(1950)$ damps out quickly as the production angle departs from zero degrees, in contrast to the well-known enhancement at 1.35 GeV/c, which is evident at all angles. (auth)

22265 MEASUREMENT OF DEUTERON–PROTON BACKWARD ELASTIC SCATTERING AT INCIDENT DEUTERON MOMENTA 3.43, 4.50, 5.75, AND 6.60 GeV/c. Dubal, L. (National Research Council of Canada, Ottawa); Hargrove, C. K.; McKee, R. J.; Mes, H.; Bird, L.; Halliwell, C.; Hincks, E. P.; Morrison, R. W.; Walters, J.; Thompson, A. C. pp 209-212 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973). See CONF-730642-.

Differential cross sections for dp elastic scattering in the range 60°-175° CM were measured at 3.43, 4.50, 5.75, and 6.60 GeV/c incident deuteron momentum. Data are compared with predictions of the one pion exchange model and the baryon pick-up model. A reasonable fit to the momentum variation and differential cross sections are found for the one pion exchange model. When the data are plotted against the variable Δ of the baryon pick-up model, the s-dependence is greatly reduced. (auth)

22266 CERN INTERSECTING STORAGE RINGS AND STRONG INTERACTIONS AT HIGH ENERGIES. Cocconi, G. (CERN, Geneva). Postepy Fiz.; 25: No. 3, 223-241(1974). (In Polish).

The coming into operation of the Intersecting Storage Rings (ISR) at the European Center of Nuclear Research (CERN), near Geneva, has made it possible in the past two years to study the behavior of matter at the highest densities ever obtained artificially, hundreds of times greater than the density of matter in nuclei and even in the densest stars. After a description of the facility, an account is given of some of the results obtained thus far, followed by a brief discussion of possible future developments. (10 figures) (auth)

Strong (Meson-induced)

Refer also to abstracts 21996 and 22177.

22267 (CEA-N-1703) MEASUREMENT OF SPIN ROTATION PARAMETERS IN π-PROTON ELASTIC SCATTERING AND DETERMINATION OF THE SCATTERING AMPLITUDES. de Lesquen, A. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Mar 1974. 135p. (In French). Dep. NTIS (US Sales Only) $9.75.

Thesis. Submitted to Paris Univ., Orsay (France).

The spin rotation parameters were measured for π^+ or π^-p at 6 GeV/c and for π^-p at 16 GeV/c, with t ranging from -0.19 to -0.51 $(GeV/c)^2$. The direction of the target polarization was within the scattering plane. The recoil proton polarization was measured in a polarimeter composed of a set of carbon plates alternated with spark chambers. The averaged values are: $R(\pi^-) = -0.23$ and $R(\pi^+) = -0.08$ with $A(\pi^-)$ closed to +1. With these results it was possible to calculate the scattering amplitudes, without the help of theoretical models, for both I = 0 and I = 1 isospin states in the crossed channel. (auth)

22268 (COO-2009-76) SEARCH FOR BACKWARDS-PRODUCED EXOTIC MESON RESONANCES IN 8.4 GeV/c π^+p INTERACTIONS. Alam, M. S.; Brabson, B. B.; Galloway, K.; Mercer, R.; Baggett, N. V.; Fowler, E. C., Huebschman, M. L.; Kreymer, E.; Rogers, A. H.; Baglin, C.; Hanlon, J.; Kamat, R.; Panvini, R.; Petraske, E.; Stone, S.; Waters, J.; Webster, M. (Indiana Univ., Bloomington (USA); Purdue Univ., Lafayette, Ind. (USA); Stanford Linear Accelerator Center, Calif. (USA); Vanderbilt Univ., Nashville, Tenn. (USA)). 1974. 20p. (CONF-740713-16). Dep. NTIS $4.00.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

Results are reported from a hybrid experiment designed to search for backwards-produced charge = +2 exotic meson resonances by investigating the reaction $\pi^+ + p \rightarrow X^{++} + n$(forward) at 8.4 GeV/c. The SLAC 15-inch rapid cycling bubble chamber was used with a downstream neutron detector. From a theoretical point of view, the backwards-production reaction is a favored

mode of exotic meson production if two-component duality arguments are meaningful. The data reported here is at a statistical level corresponding to approximately 30 events per microbarn. No clear evidence for narrow exotic mesons was found for masses ≤3.0 GeV in the decay modes accessible for study in this experiment which included: $X^{++} \to \pi^+\pi^+$, $\pi^+\pi^+\pi^+\pi^-$, $\pi^+\pi^+\pi^+\pi^+\pi^-\pi^-$, and $\bar{p}p\pi^+\pi^+$. Upper limits are given for the cross sections of narrow resonances in addition to estimated cross sections of various final states. (auth)

22269 (ITEF-72) DEPENDENCE UPON THE SQUARE OF THE MOMENTUM TRANSFER OF THE INCLUSIVE CROSS SECTION OF THE REACTION $\pi^- + p \to p$ + ANYTHING IN THE REGION OF FRAGMENTATION OF THE INCIDENT PARTICLES AT 2.13 AND 2.69 GeV/c. Abramov, B. M.; Dukhovskoi, I. A.; Kishkurno, V. V.; Krutenkova, A. P.; Kulikov, V. V.; Radkevich, I. A.; Fedorets, V. S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Theoreticheskoj i Ehksperimental'noj Fiziki). 1973. 12p. (In Russian). Dep. NTIS (U. S. Sales Only) $4.00.

The dependence of the inclusive cross section for the reaction $\pi^- + p \to p$ + anything on the square of the momentum transfer "U" was measured in the fragmentation region of the incident particle for energies of the incoming π^- mesons of 2.13 and 2.69 GeV. It was found that the cross section depends on U somewhat differently for different integrals of the squares of the masses M^2. A comparison with high-energy data is carried out. The factorization hypothesis is discussed. (4 figures, 1 table) (tr-auth)

22270 (JINR-E1-7923) SOME ASPECTS OF SEMI-INCLUSIVE REACTIONS IN FOUR-PRONG π^-p INTERACTIONS AT 5 GeV/c. Lebedev, R. M.; Glagolev, V. V.; Cotorobai, F.; Besliu, C.; Constantinescu, A.; Emel'yanenko, V. N.; Kuznetsova, E. S.; Sabau, M.; Saitov, I. S.; Sharkhu, G.; Zhuravleva, L. I.; Hlavacova, J.; Michalcak, I.; Patocka, I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1974. 28p. Dep. NTIS (US Sales Only) $4.50.

Some phenomenological aspects of the following semi-inclusive reactions at 5 GeV/c are presented: $\pi^-p \to \pi^+ + 3$ charged particles + X^0, $\pi^-p \to \rho^0 + 2$ charged particles + X^0, $\pi^-p \to \Delta^{++} +$ 2 charged particles + X^0, and $\pi^-p \to p + 3$ charged particles + X^0. The rapidity distribution, the behavior of the function F_2 and two-particle rapidity correlations have been studied. (auth)

22271 (JINR-E1-8046) INVESTIGATION OF THE INTERACTION OF π-MESONS WITH XENON NUCLEI AT 2.34, 3.5, 5, AND 9 GeV/c. Okhrimenko, L. S.; Slowinski, B.; Strugalski, Z. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1974. 10p. (CONF-740713-10). Dep. NTIS (US Sales Only) $4.00.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

An investigation of the characteristics of π^0-mesons, slow π^+-mesons and protons emitted in π^+−Xe interactions at 2.34 GeV/c and in π^-−Xe interactions at 3.5, 5, and 9 GeV/c was made. The results on the π^0-meson and charged particle emission multiplicity as well as the angular and momentum distributions of π^0-mesons, slow π^+-mesons and protons were obtained. It was observed that the average multiplicity of π^0-meson production decreased with increasing the number of secondary charged particles, N_{ch}, in π−Xe interactions at 2.34 and 3.5 GeV/c and was constant at 5 and 9 GeV/c. At all energy values studied the class of π−Xe interactions with small N_{ch}, in which the angular and momentum characteristics of π^0-mesons do not differ from the corresponding pion characteristics produced in π-nucleon collisions at the same energies is clearly observed. A simple statistical interpretation of these phenomena is given. An average value of kinetic energy of protons emitted in π−Xe interactions at 2.34 GeV/c does not depend on the number N_{ch} and is equal approximately to one half of the pion mass. The neutral boson resonance production ($\eta^0 \to 2\gamma$, $3\pi^0$; $\omega^0 \to \pi^0\gamma$) is mostly observed only in π−Xe interactions with small secondary charged particle numbers. (auth)

22272 (JINR-E1-8061) EXPERIMENTAL RESULTS ON EXCLUSIVE PROCESSES. Lanius, K. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1974. 58p. (CONF-740629-3). Dep. NTIS (US Sales Only) $6.00.

From 5th international symposium on many particle hadrodynamics; Leipzig, F.R. Germany (4 Jun 1974).

A report is given on exclusive multi-particle production. Some new results are described on few-body reactions obtained with the partial wave analysis and with the prism plot analysis. A new method is described in order to analyze few-body reactions. Some results on many-body reactions ($n \geq 5$) are given. (auth)

22273 (JINR-P1-7969) INELASTIC π^+p INTERACTIONS AT 230 AND 275 MeV. Batusov, Yu. A.; Bunyatov, S. A.; Gulkanyan, G. R.; Sidorov, V. M.; Musakhanov, M.; Ionitse, G.; Loznyanu, E.; Mikhul, V.; Tuvdendorzh, D. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1974. 20p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

The $\pi^+p \to \pi^+\pi^+n$ reaction cross section was measured at T_π = 230 MeV. The isotopically invariant amplitudes of the $\pi N \to \pi\pi N$ reactions on the threshold in the states P_{11} and P_{31} were determined. In the framework of the "soft" pion theory there were determined the s-wave ππ scattering lengths: $a_0 = 0.18 \pm 0.02$ m_π^{-1}, $a_2 = -0.07 \pm 0.01$ m_π^{-1}. The estimates of the cross sections of the $\pi^+p \to \pi^+\pi^0p$ reaction at T_π = 230 MeV and T_π = 275 MeV and of the $\pi^+p \to \pi^+\pi^+n$ reaction at T_π = 275 MeV were obtained. There were determined the cross sections of the radiation scattering of π^+-meson on a proton with the emission of hard γ-quanta ($E_\gamma >$ 50 MeV) at 230 and 275 MeV. The experiment was performed at the synchrocyclotron of the Laboratory of Nuclear Problems (JINR). (auth)

22274 (JINR-P1-8036) CHARGE EXCHANGE IN π^-p^- INTERACTIONS AT 40 GeV/c. Angelov, N.; Ivanovskaya, I. A.; Kladnitskaya, E. N.; Mel'nikova, N. N.; Mikhul, A.; Fadeev, N. G.; Aniola, L.; Bartke, E. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1974. 16p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

Multiparticle production in π^-p-interactions was studied from a viewpoint of charge exchange between the total charge of forward going particles and of the incident π^--meson. The average charge exchange was found to be equal to $\langle\Delta Q\rangle = 0.490 \pm 0.015$. The most part of inelastic events (≈80%) have $\Delta Q = 0$ and $Q = 1$, thus indicating to the essential role of multiperipheral processes. Distributions on value $(\Delta Q - \langle\Delta Q\rangle)$ do not depend upon the type of colliding particle and energy in the interval of (10−205 GeV/c). The average charge exchange and the dispersion of ΔQ values are compared with the predictions of multiperipherical and fragmentation models. (auth)

22275 (KFKI-74-18) INCLUSIVE $\pi^-p \to \gamma$ + ANYTHING AND $\pi^-C^{12} \to \gamma$ + ANYTHING REACTIONS AT 40 GeV/c. Bucharest-Budapest-Kracow-Dubna-Hanoi-Moscow-Sofia-Tashkent-Tbilisi-Ulan-Bator-Warsaw Collaboration. (Kozponti Fizikai Kutato Intezet, Budapest (Hungary)). 1974. 14p. Dep. NTIS (US Sales Only) $4.00.

Some results on inclusive γ- and π^0 spectra in π^-p and π^-C^{12} interactions at 40 GeV/c are reported. It is shown that there is no factorization of the structure function $f(q_\perp, x)$ in $\pi^-p \to \gamma +$ anything reactions for $q_\perp \leq 0.4$ GeV/c and $|x| \leq 0.16$. The π^0-mesons longitudinal momentum spectrum in CMS is obtained by applying the method of statistical regularization to the measured γ spectrum. In the range $|x| \leq 0.02$, $N_{\pi^+} = N_{\pi^-} = N_{\pi^0}$ within the error /+7%/. The inclusive γ-spectra in π^-p and π^-C^{12} interactions indicate that the normalized structure function is the same for both reactions over the central and the beam fragmentation regions. (auth)

22276 (KHFTI-73-9, pp 46-48) PRODUCTION OF $\pi^+2\pi^-$ SYSTEM ON NUCLEI AT LOW MOMENTUM TRANSFER. Vasil'kova, A. D.; Gornov, M. G.; Kirillov-Ugryumov, V. G.; Levina, V. I.; Protasov, V. P.; Sergeev, F. M. (Moscow Engineering-Physics Inst.). 1973. (In Russian).

In a bubble chamber with a mixture of light freons the reaction $\pi^- + A \to A^+ + 2\pi^-\pi^+$ was studied in the region of small momentum transfer. An analysis showed that the yield of the specific reaction depends on the masses of the three particles formed. The mass distribution of the systems $(\pi^+2\pi^-)$ and $(\pi^+\pi^-)$ and the distribution of the longitudinal momentum of π^+ and π^- mesons were reported. (tr-auth)

22277 (KHFTI-73-9, pp 49-51) ANALYSIS OF EXPERIMENTS ON THREE-PION PRODUCTION ON NUCLEI AT 5 AND 15 GeV IN GLAUBER MODEL. Korotkikh, V. L. (Inst. of Nuclear Physics, Moscow); Magzumov, E. Zh.; Gershkovich, A. M. 1973. (In Russian).

The process $\pi^- + A \to A^+ + \pi^-\pi^+\pi^-$, where A and A^+ are the initial and final nuclei respectively, was analyzed. The differential cross section for the formation of three pions on nucleons was calculated. The results were compared with experimental data. (tr-auth)

22278 (RL-74-41, pp 14-15) K^+, π^+, π^-, K^-−p ELASTIC SCATTERING DIFFERENTIAL CROSS SECTIONS. May 1974.

22279 (RL-74-41, pp 14; 16-17) STUDY OF THE PRODUCTION OF NARROW WIDTH MESONS IN π^-p INTERACTIONS. May 1974.

22280 (RL-74-41, pp 19-21) DIFFERENTIAL CROSS SECTIONS IN THE CHARGE EXCHANGE REACTIONS $\pi^-p \to \pi^0n$ AND $\pi^-p \to \eta^0n$. May 1974.

22281 (RL-74-41, pp 52-54) PARAMETERS OF THE τ AND SEMI-LEPTONIC DECAYS OF K_L^0 ; K_L^0 p INTERACTIONS IN THE RANGE 450–800 MeV/c. May 1974.

22282 (RL-74-41, pp 56-7) K^-p INTERACTIONS IN THE 1 GeV/c REGION. May 1974.

22283 (TID-26612) NEUTRAL PARTICLE PRODUCTION FROM π^+p INTERACTIONS AT 10.5 GeV/c. Elliott, J. R.; Fortney, L. R.; Goshaw, A. T.; Loos, J. S.; Robertson, W. J.; Walker, W. D.; Yeager, W. M.; Meisner, G. W.; Muir, R. B. (Duke Univ., Durham, N. C. (USA). Dept. of Physics; North Carolina Univ., Greensboro (USA). Dept. of Physics). [nd]. 14p. Dep. NTIS $4.00.

A preliminary exploration was made of the use of gamma rays detected in a neon-hydrogen bubble chamber to measure inclusive π^0 production in 10.5 GeV/c π^+p interactions. The data presented represent less than 10 percent of the final statistics on $\pi^\pm p$ collisions from 5 to 15 GeV/c. The gamma ray detection technique is found to work well and should be useful for future, more complete, studies of $\pi^\pm$ proton interactions in this energy range. (LBS)

22284 CROSS-CHANNEL ISOSPIN ANALYSIS OF 3.9 GeV/c $\pi^+p \rightarrow \pi(N\pi)$ AND FURTHER EVIDENCE FOR LOW MASS I = 1/2 ($N\pi$) ENHANCEMENT. Kistiakowsky, V.; Haber, B.; Hodous, M.; Hulsizer, R.; Levy, A.; Pless, I.; Singer, R.; Wolfson, J.; Yamamoto, R. (Massachusetts Inst. of Tech., Cambridge). pp 103-106 of Baryon Resonances, 73. West Lafayette, IN; Purdue Univ. (1973).

From conference on baryon resonances; West Lafayette, Indiana, USA (20 Apr 1973). See CONF-730477-.

The mass distributions and squared-amplitude and interference terms were found from a cross-channel isospin analysis of the reaction $\pi + p \rightarrow \pi(\pi N)$ at 3.9 GeV/c in a bubble chamber. (JFP)

22285 π^+p ELASTIC SCATTERING BETWEEN 1.2 AND 2.3 GeV/c. Abe, K. (Maryland Univ., College Park); Barnett, B. A.; Goldman, J. H.; Laasanen, A. T.; Steinberg, P. H.; Marmer, G. J.; Moffett, D. R.; Parker, E. F. pp 107-111 of Baryon Resonances, 73. West Lafayette, IN; Purdue Univ. (1973).

From conference on baryon resonances; West Lafayette, Indiana, USA (20 Apr 1973). See CONF-730477-.

The $\pi^+ + p$ elastic differential cross sections were measured at 1.2 to 2.3 GeV/c. The center-of-mass angular coverage extended from $0.9 > \cos\theta > -0.9$. (JFP)

22286 REVIEW OF K^+p SCATTERING EXPERIMENTS AND PHASE SHIFT ANALYSES SINCE 1970. Dowell, J. D. (Birmingham Univ., Eng.). pp 157-174 of Baryon Resonances, 73. West Lafayette, IN; Purdue Univ. (1973).

From conference on baryon resonances; West Lafayette, Indiana, USA (20 Apr 1973). See CONF-730477-.

Measurements of K^+p scattering since the Duke conference on hyperon resonances in 1970 are reviewed. These include large additions to the elastic differential cross sections as well as more total cross section and inelastic cross section data. The sign of the low energy phase shift was unambiguously confirmed to be negative and the anomalous dip in the total cross section at 0.7 GeV/c has disappeared. Phase shift analyses, some including higher partial waves to which the data are now sensitive and using different methods, agree on the qualitative features in the Z_1^+ region but ascribe differing amounts of inelasticity to the partial wave amplitudes. Both elastic and inelastic scattering indicate a large nonresonant background in the P13 partial wave making it almost impossible ever to decide whether there is a resonance there. Theoretical input rather than more data seems to be the better approach to a unique solution at the present time. (auth)

22287 K^+p ELASTIC SCATTERING BETWEEN 0.7 AND 1.9 GeV/c. Charles, B. J. (Bristol Univ., Eng.); Edwards, T. R. M.; Gibson, W. M. pp 179-185 of Baryon Resonances, 73. West Lafayette, IN; Purdue Univ. (1973).

From conference on baryon resonances; West Lafayette, Indiana, USA (20 Apr 1973). See CONF-730477-.

Measurements of the differential and total elastic cross sections for $K^+ + p$ elastic scattering at 19 momenta in the range 0.7 to 1.9 GeV/c are reported. (JFP)

22288 STRUCTURE IN THE K^+ NUCLEON, I = 0 TOTAL CROSS SECTION BELOW 1.1 GeV/c. Michael, D. N. (Brookhaven National Lab., Upton, NY). pp 187-198 of Baryon Resonances, 73. West Lafayette, IN; Purdue Univ. (1973).

From conference on baryon resonances; West Lafayette, Indiana, USA (20 Apr 1973). See CONF-730477-.

New precision measurements were carried out of the total cross sections of positive kaons on hydrogen and deuterium in the range of laboratory momentum from 410 to 1065 MeV/c. A very broad elastic structure in the I = 0 state is inferred. Whether or not this is due to the formation of an exotic Z_0^+ resonance must be established from further phase shift analysis of the I = 0 state. (auth)

22289 STRUCTURES IN K^-N TOTAL CROSS SECTION BETWEEN 0.4 AND 1.1 GeV/c. Li, K. K. (Brookhaven National Lab., Upton, NY). pp 283-292 of Baryon Resonances, 73. West Lafayette, IN; Purdue Univ. (1973).

From conference on baryon resonances; West Lafayette, Indiana, USA (20 Apr 1973). See CONF-730477-.

Total cross sections of negative kaons on hydrogen and deuterium from 417 to 1067 MeV/c laboratory momentum were measured in an experiment using the transmission method. A new structure at center of mass energy of about 1590 MeV in the I = 1 state is observed. (auth)

22290 NEW DATA ON THE REACTION $K^-p \rightarrow \Lambda\pi^0$ FROM 1.93 TO 2.23 GeV/c AND PARTIAL WAVE ANALYSIS FOR THIS REACTION BETWEEN 2070 AND 2370 MeV CMS ENERGY. de Bellefon, A. (College de France, Paris); Berthon, A.; Brunet, J.; Tristram, G.; Vrana, J.; Poulard, G.; Tallini, B. pp 293-303 of Baryon Resonances, 73. West Lafayette, IN; Purdue Univ. (1973).

From conference on baryon resonances; West Lafayette, Indiana, USA (20 Apr 1973). See CONF-730477-.

Results of a partial wave analysis for the reaction $K^-p \rightarrow \Lambda\pi^0$ in the cms energy region between 2070 and 2370 MeV, including new data on this reaction from 2200 to 2370 MeV are presented. Two new resonances are required to fit the data: one in the D_{15} (or P_{13}) state with mass M ~ 2290 MeV, the other in the G_{19} (or $H_{1,11}$) state with mass M ~ 2215 MeV. (auth)

22291 K^-p ELASTIC DIFFERENTIAL CROSS SECTION BETWEEN 1.4 AND 1.9 GeV/c. Abe, K. (Maryland Univ., College Park); Barnett, B. A.; Goldman, J. H.; Laasanen, A. T.; Steinberg, P. H.; Marmer, G. J.; Moffett, D. R.; Parker, E. F. pp 305-310 of Baryon Resonances, 73. West Lafayette, IN; Purdue Univ. (1973).

From conference on baryon resonances; West Lafayette, Indiana, USA (20 Apr 1973). See CONF-730477-.

Structure in the differential cross sections for $K^- + p$ elastic scattering at 1.4 to 1.9 GeV/c is described. (JFP)

22292 OBSERVATION OF A P_{11} $\Sigma(1650)$ IN THE ELASTIC AND CHARGE-EXCHANGE CHANNELS OF A K^-p FORMATION EXPERIMENT. Hart, E. L. (Tennessee Univ., Knoxville); Rice, R. M.; Bacastow, R. B.; Fung, S. Y.; Hertzbach, S. S.; Ponte, R.; Button-Shafer, J.; Yamamoto, S. S.; Evans, D. A. pp 311-314 of Baryon Resonances, 73. West Lafayette, IN; Purdue Univ. (1973).

From conference on baryon resonances; West Lafayette, Indiana, USA (20 Apr 1973). See CONF-730477-.

A sample of 26,000 elastic and 6000 charge-exchange events was measured from an exposure of the BNL 30" hydrogen bubble chamber to K^- mesons at 8 momenta between 690 and 840 MeV/c. An energy-dependent partial-wave analysis of these channels yields a best fit for a solution including the $\Lambda(1670)$, $\Lambda(1690)$, and a P_{11} $\Sigma(1650)$ which has been previously suggested in K^-p formation and production experiments. The D_{13} $\Sigma(1670)$ does not appear to be present. (auth)

22293 $K^-p \rightarrow \Sigma^0\pi^0$ CROSS SECTION BETWEEN 1575 AND 1710 MeV CM ENERGY RANGE WITH DETECTION OF GAMMAS. Chu, R. Y. L. (Brookhaven National Lab., Upton, NY); London, G. W.; Yu, Y. P. pp 315-322 of Baryon Resonances, 73. West Lafayette, IN; Purdue Univ. (1973).

From conference on baryon resonances; West Lafayette, Indiana, USA (20 Apr 1973). See CONF-730477-.

A measurement of the $K^-p \rightarrow \Sigma^0\pi^0$ cross section is presented using only events with all 3 γ detected, between 1600 and 1700 MeV in center of mass. Comparison is made to previous results. (auth)

22294 NEUTRAL PARTICLE FINAL STATES FROM K^-p INTERACTIONS IN THE RANGE FROM 690 TO 934 MeV/c. Baxter, D.; Buckingham, I.; Corbett, I. (Oxford Univ.). pp 323-331 of Baryon Resonances, 73. West Lafayette, IN; Purdue Univ. (1973).

From conference on baryon resonances; West Lafayette, Indiana, USA (20 Apr 1973). See CONF-730477-.

The reactions $K^-p \rightarrow \Lambda\pi^0$, $\Sigma^0\pi^0$ and $\Lambda\eta$ were studied in the K^- momentum range from 690 to 934 MeV/c. Detection of the charged particles was in thin plate optical and wire spark chambers. Differential cross section results are presented, with energy dependent, single channel partial wave analysis. In the $\Sigma^0\pi^0$ channel, a resonant amplitude of −0.20 is obtained from the D03 resonance. (auth)

22295 APPLICATION OF HIGH ENERGY MODELS TO EXPERIMENTAL DATA OF Kp INTERACTIONS. Markytan, M. (Institut fuer Hochenergiephysik, Vienna). pp 6-28 of Proceedings of the Triangle Seminar. Haberler, P. L. F. (ed.). Vienna; Institut fuer Hochenergiephysik, Oesterreichische Akademie der Wissenschaften (1972).

From triangle seminar on experimental high energy physics; Vienna, Austria (9 Oct 1972). See CONF-7210121-.

The analysis of Kp interaction data covers the experimental analysis, the calculation of inclusive longitudinal momentum spectra of pions with the Hagedorn model, differential cross sections of the reaction $K^-p \to \pi^- +$ anything and predictions for the reactions $\gamma p \to \pi^- +$ anything and $\pi^- p \to \pi^- +$ anything using factorization, test of s- or t-channel helicity conservation in $(p\pi^+\pi^-)$, $(K^-\pi^+\pi^-)$, $(K^-\pi^+\pi^-)$, $(\pi^+\pi^+\pi^-)$, and $(\pi^-\pi^+\pi^-)$ production in 16 GeV/c K^-p interactions, and analysis of the reaction $K^-p \to K^-\pi^-\Delta^{2+}$ at 8.25 GeV/c. (JFP)

22296 MULTIPLICITY DISTRIBUTIONS OF π^+p EVENTS IN PROPANE BUBBLE CHAMBER EXPOSED TO 40 GeV/c BEAM. Bucharest-Budapest-Krakow-Dubna-Hanoi-Serpuchov-Sofia-Tashkent-Tbilisi-Ulan-Bator-Warsaw Coll. pp 29-33 of Proceedings of the Triangle Seminar. Haberler, P.L.F. (ed.). Vienna; Institut fuer Hochenergiephysik, Oesterreichische Akademie der Wissenschaften (1972).

From triangle seminar on experimental high energy physics; Vienna, Austria (9 Oct 1972). See CONF-7210121-.

The results of investigations of inelastic π^-N interactions with γ quanta and V^0 are presented and include the average values of transverse momenta of secondary particles, various distributions, structure functions, rapidity distributions, distribution asymmetry of secondary photon longitudinal momenta, and neutral strange particle production cross sections. (JFP)

22297 PROGRESS REPORT ON THE ACTIVITIES OF THE EXPERIMENTAL GROUP OF THE VIENNA HIGH ENERGY PHYSICS INSTITUTE. Steuer, M. (Institut fuer Hochenergiephysik, Vienna). pp 47-50 of Proceedings of the Triangle Seminar. Haberler, P. L. F. (ed.). Vienna; Institut fuer Hochenergiephysik, Oesterreichische Akademie der Wissenschafter (1972).

From triangle seminar on experimental high energy physics; Vienna, Austria (9 Oct 1972). See CONF-7210121-.

Experimental research on πp interactions is summarized. (JFP)

22298 NEUTRAL KAON REGENERATION IN THE MOMENTUM REGION OF 14 TO 50 GeV/c. Dubna-Serpukhov-Budapest-Prague Collaboration. pp 51-61 of Proceedings of the Triangle Seminar. Haberler, P. L. F. (ed.). Vienna; Institut fuer Hochenergiephysik, Oesterreichische Akademie der Wissenschaften (1972).

From triangle seminar on experimental high energy physics; Vienna, Austria (9 Oct 1972). See CONF-7210121-.

New results for the decay zone enlarged from 6 to 9 m in length are presented for neutral kaon transmission regeneration measurements on hydrogen in the momentum region of 14 to 42 GeV/c. The invariant mass time, and angular distributions, the regeneration amplitude and total cross section difference are shown. (JFP)

22299 PRELIMINARY RESULTS OF THE POLARIZATION OF THE REACTION $\pi^+ + p \to \Sigma^+ + K^+$ at 3.5 GeV/c. CERN-Trieste High-Energy Group. pp 90-119 of Proceedings of the Triangle Seminar. Haberler, P. L. F. (ed.). Vienna; Institut fuer Hochenergiephysik, Oesterreichische Akademie der Wissenschaften (1972).

From triangle seminar on experimental high energy physics; Vienna, Austria (9 Oct 1972). See CONF-7210121-.

A counter and wire spark chamber experiment to measure the polarization of the reactions $\pi^+ + p \to p + \pi^+$ at 2, 3.5, and 4 GeV/c, and $\pi^+ + p \to \Sigma^+ + K^+$ at 2 and 3.5 GeV/c, in the backward region is finished. Detailed information about the analysis of the ΣK events is given, as well as polarization results for the 3.5 GeV/c data. (auth)

22300 MOMENTUM MEASUREMENTS IN THE FRINGING FIELD OF A POLARIZED TARGET MAGNET. CERN-Trieste High-Energy Group. pp 120-136 of Proceedings of the Triangle Seminar. Haberler, P. L. F. (ed.). Vienna; Institut fuer Hochenergiephysik, Oesterreichische Akademie der Wissenschaften (1972).

From triangle seminar on experimental high energy physics; Vienna, Austria (9 Oct 1972). See CONF-7210121-.

In a spark chamber experiment with a polarized target, the momentum of the backward scattered particles has been measured by magnetic analysis of the trajectory, using the polarized target magnet itself. The $\pi + p\uparrow \to p + \pi$ and $\pi + p\uparrow \to \Sigma^+ + K^+$ interactions were studied at 3.5 GeV/c. A fast algorithm has been set up to obtain the momentum value from the input data, avoiding the use of tracking procedures. The precision of the method, as well as the momentum resolution of the experimental apparatus, are discussed. (auth)

22301 $\pi\pi$ INTERACTION AND N* PRODUCTION IN HIGH ENERGY π^-p COLLISIONS. Dhar, S. Durham, NC; Duke University (1974). 193p. University Microfilms Order No. 74-16,587.

Thesis (Ph.D.).

The results of an investigation on the $\pi\pi$ scattering properties and the production of low mass baryon resonances and their spins and parities are presented. The data set is composed of events of the types of $\pi^-p \to \pi^-\pi^0P$, $\pi^-p \to \pi^-\pi^+n$, and $\pi^-p \to \pi^-\pi^-p\pi^+$; the momentum of the incident π ranging from 1.89 up to 25.0 GeV/c. The objective was to utilize the large selection of data at different incident momenta to determine the $\pi\pi$ phase shifts and the production cross section of low lying N* resonances which decay in the $N\pi\pi$ mode. For the analysis of the $\pi\pi$ system the Durr-Pilkuhn modified One Pion Exchange (OPE) model was used with a reasonable prescription for the subtraction of non-OPE events for determining the $\pi\pi$ scattering cross section. An angular distribution analysis was performed to determine the phase shifts. The I = 2 and I = 1 phase shifts are in agreement with the accepted values. For the I = 0, I = 0 phase shift our values are in agreement with the so called "up-down" solution. At high energy, the $\pi^-\pi^-$ elastic scattering cross section decreases steadily from 4.0 millibarns to less than 1.0 millibarn from 1.5 GeV/c^2 to 4.0 GeV/c^2 in the dipion mass. The total cross section as determined by the optical theorem is about the same as for the $\pi^+\pi^-$ case in the same mass range. The production of three identifiable N*'s with $N\pi\pi$ and substantial Δ^{++}_{π} decay modes was observed. The three N*'s are tentatively identified as the N*(1.47), N*(1.52), and the N*(1.69) of the Particle Data Table. These enhancements are present at all incident momenta from 5.0 GeV/c up to 25.0 GeV/c. The production cross-sections are slowly varying and are in the range 2-15 microbarns. (Diss. Abstr. Int., B)

22302 FINAL STATES $\pi^-p(m\pi^0)$ AND $\pi^-\pi^-\pi^+p(m\pi^0)$, $m \geq 1$, AS PRODUCED BY 25 GeV/c π^-p INTERACTIONS. Davis, J. L. Madison, WI; University of Wisconsin (1973). 123p. University Microfilms Order No. 74-10,236.

Thesis (Ph.D.).

The final states $\pi^-p(m\pi^0)$ and $\pi^-\pi^-\pi^+p(m\pi^0)$, $m \geq 1$, as produced by 25 GeV/c π^-p interaction in the 80-inch BNL hydrogen bubble chamber, with the proton identified by ionization in all cases. The cross section for each reaction is given, and its energy dependence for the two single-π^0 reactions is compared. The four-momentum transfer distribution and the density matrix elements for ρ^- production in the two-prong case both suggest an important ω-exchange, as well as a one-pion-exchange (OPE) contribution. There is no evidence of the g(1680) in the dipion system. Assuming OPE only, the formalism of Wolf is used to calculate the elastic and total $\pi^-\pi^0$ diffractive scattering cross sections in the region $1.8 < M(\pi^-\pi^0) < 4.2$ GeV/c^2. The minimum value attained by $\sigma_t(\pi^-\pi^0)$ is 20 ± 5 mb, and this is compared with results reported elsewhere for $\sigma_t(\pi^-\pi^+)$ and $\sigma_t(\pi^-\pi^-)$. The invariant mass spectra of the many particle combinations in the four-prong single-π^0 reaction is studied and it is found that the $\Delta^{++}(1236)$, ρ^-, and ρ^0 are strongly produced. There is weak evidence of a G = -1 enhancement [which is clearly not the $A_3^-(1640)$] in the R(1700) region, similar to the one recently seen in the same reaction at 18.5 GeV/c. The production and decay modes of the B(1235) and ρ(1710) are discussed. Evidence is presented which indicates that the proton diffractively dissociates into $p\pi^0$ (in both single-π^0 reactions) and $p\pi^-\pi^+\pi^0$ final states. It is also shown that the amount of double dissociation into the quasi-two-body system A_1^- ($p\pi^0$) can be predicted at least qualitatively by assuming that it is dominated by simple Pomeron exchange and that the vertex amplitudes factorize. A simple kinematic study, in terms of the Feynman variable, x, was carried out for both single-π^0 reactions, and the effects on the x-distributions of specific dynamical mechanisms were noted. The two interesting features of the multiple-π^0 reactions were found in the missing negative boson mass spectrum for four-prong events. There was a small, broad enhancement in the R(1700) region, and a narrow($\Gamma \sim 50$ MeV/c^2) 4-standard deviation peak at 2352 ± 8 MeV/c^2, the latter produced entirely with $-t_{pp} < 0.20$ (GeV/c)^2. (Diss. Abstr. Int., B)

22303 MULTIPLE EMISSION OF PARTICLES IN π^-Xe INTERACTION AT 3.5 GeV/c. Okhrimenko, L. S.; Slovinskii, B.; Strugal'skii, Z. S.; Tomashevich, A. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 19: No. 6, 1262-1265(Jun 1974). (In Russian).

The distributions of the number of the secondary charged and neutral particles from the π^-Xe interactions at 3.5 GeV/c recorded by the xenon bubble chamber are analyzed. A three-parameter function approximating the experimental distribution of the total number of the secondary particles being observed is proposed.

The frequency of the π^0 meson production is given in their whole energy range. (auth)

22304 DIFFERENTIAL CROSS SECTIONS AND SCALING INVARIANCE IN THE $\pi^-p \to X^-p$ REACTION AT 25 AND 40 GeV/c. Antipov, Yu. M. (Joint Experiment Inst. of High Energy Physics, Serpukhov, USSR); Buchello, R.; Vaich, A. Yadern. Fiz.; 19: No. 6, 1270-1275(Jun 1974). (In Russian).

The differential cross sections of the inclusive reaction $\pi^- + p \to p + X^-$ at 70 GeV are measured as a function of the incident particle momentum, of the missing mass square and of the transfer momentum. The dependence of the Lorentz invariant differential cross section upon the scaling variable $x = p_{||}/p_{||_{max}}$ (c.m.) is investigated. (auth)

22305 $\eta\pi$ MASS SPECTRUM FROM THRESHOLD TO 1200 MeV/c^2 IN THE REACTION $\pi^-p \to \pi^-\eta p$. Witherell, M. S. Madison, WI; Univ. of Wisconsin (1973). 140p. University Microfilms Order No. 74-9028.

Thesis (Ph. D.).

The $\eta\pi$ mass spectrum from the reaction $\pi^-p \to X^-p$, $X^- \to \eta\pi^-$, $\eta \to \gamma\gamma$ was studied in an optical spark chamber experiment. The experiment was carried out in two runs, the first of which observed the mass region 1000 to 1500 MeV/c^2 at 6.0 GeV/c beam momentum in the region $0.27 < |t| < 0.42$ (GeV/c)^2. The results of this run, in which the $\eta\pi$ mass spectrum is dominated by a large A_2 signal, have previously been published. The data of the second run are presented which were taken at a beam momentum of 4.5 GeV/c in the t-range $0.11 < |t| < 0.32$ (GeV/c)^2 and which include the mass range from threshold to 1200 MeV/c^2. A $3\frac{1}{2}$ standard deviation peak is observed in the $\eta\pi$ mass spectrum at a mass of 980 MeV/c^2, which is identified with the $\pi_N(980)$ previously seen in KN production experiments and in cascade decay of the D°. A least squares fit to the spectrum yields Breit-Wigner parameters $M_0 = (980 \pm 11)$ MeV/c^2 and $\Gamma_0 = (60^{+40}_{-30})$ MeV/c^2, and the total production cross section at 4.5 GeV/c is calculated to be $(1.5 \pm 0.7)\,\mu$b. The angular distribution for the $\pi_N(980)$ is consistent with isotropy, in agreement with the assignment $J^P = 0^+$. No other resonances are observed in the $\eta\pi$ system, with an upper limit on the cross section which is typically 1 μb at 90% confidence level for narrow resonances. In addition to the 4.5 GeV/c data, some further results on the 6.0 GeV/c run are included. The angular distribution for the decay $A_2^- \to \eta\pi^-$ is presented, and the density matrix elements are obtained. All elements are consistent with zero except for ρ_{11}, ρ_{1-1}, and ρ_{00}, and the fit yields the values $\rho_{11} = (0.45 \pm 0.02)$, $\rho_{1-1} = (0.45 \pm 0.04)$, $\rho_{00} = (0.09 \pm 0.04)$. A missing mass analysis of the A_2 at 6.0 GeV/c is also presented, based on a sample of 22,500 events of the reaction $\pi^-p \to X^-p$ with $1.00 < M(X^-) < 1.50$ GeV/c^2, of which 6200 are A_2's. The mass spectrum is fit well by a single D-wave Breit-Wigner with $M_0 = (1.324 \pm 0.003)$ GeV/c^2 and $\Gamma_0 = (0.104 \pm 0.009)$ GeV/c^2. These values agree well with the values $M_0 = (1.323 \pm 0.003)$ GeV/c^2 and $\Gamma_0 = (0.108 \pm 0.009)$ GeV/c^2 previously reported for the $A_2 \to \eta\pi$ events from the same film. The spectrum shows no evidence of double-peaked structure, and a dipole fit gives a χ^2 probability of less than 10^{-6}. (Diss. Abstr. Int., B)

22306 NEW MEASUREMENTS OF PION-PROTON BREMSSTRAHLUNG IN THE REGION OF THE $\Delta(1236)$ RESONANCE. Nefkens, B. M. K.; Arman, M.; Glodis, P.; Haddock, R. P.; Leung, K. C.; Schrock, B. L.; Sober, D. I.; Sperinde, J. M. (Univ. of California, Los Angeles). pp 51-54 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973). See CONF-730642-.

The conspicuous absence of a sizeable peak in the photon spectrum of the reaction $\pi^+p \to \pi^+p\gamma$ due to the Δ^{++} (1236) resonance, has been further investigated. Measurements have been extended to include nine new photon angles so as to cover the full angular range, $\theta(\gamma) = 0°$-$360°$, and to investigate two c.m. energies, $\sqrt{s}$ = 1 306 and 1 275 MeV. As in the original experiment, $\theta(\pi) \propto -50°$ and $\theta(p) = 10°$-$60°$. The photon spectra observed at all angles, for both energies and for π^+ and π^-, are monotonically decreasing with increasing photon energy, and devoid of any significant structure. Thus the hypothesis of an accidental cancellation to explain the absence of a clear Δ^{++} (1236) peak in the data is shown experimentally to be untenable. (auth)

22307 ERICSON FLUCTUATIONS IN HIGH-ENERGY HADRON PHYSICS. Carlson, P. J. (CERN, Geneva). pp 55-61 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973). See CONF-730642-.

Fluctuation phenomena are well known in many branches of physics. In particular, nuclear reactions and scattering cross-sections show a randomness when the energy levels in the compound nucleus overlap. It has been suggested that these Ericson fluctuations may also be present in particle physics. Evidence is presented for Ericson fluctuations in large angle πp elastic scattering at an incident laboratory momentum of 5 GeV/c. The fluctuations are found to be larger in π^+p than in π^-p. A quantitative evaluation of the fluctuating differential cross-section as a function of energy for 0° and 180° πp elastic scattering is shown to be consistent with the observations in large angle scattering at 5 GeV/c, and is taken as support for an exponentially increasing density of hadron states. (auth)

22308 STUDY OF THE X^0 MESON DECAYING IN TO $\pi\pi\eta$. Upadhyah, P. N. (Gaya Coll., India). Indian J. Pure Appl. Phys.; 12: No. 1, 49-50(Jan 1974).

An enhancement produced in the interaction $\pi^-p \to X^0 n$ near its production threshold over a range of four-momentum transfer, t, from -0.38 to -0.79 (GeV/c)^2 was observed in the decay mode at mass 956 ± 3 MeV/c^2 with width $\Gamma \leq 12$ MeV/c^2 in a missing-mass counter experiment. The missing mass of the X^0 was calculated by measuring the incident pion momentum and the neutron time of flight. The decay signature is consistent with $X^0 \to \pi\pi\eta$, but $\delta^0 \to \eta\pi^0$ cannot be ruled out. (2 figures) (auth)

Particle Interactions and Properties (Theoretical)

Refer also to abstract 22225.

General

Refer also to abstract 22943.

22309 (ITEF-47) JOINT ANALYSIS OF THE AGGREGATE OF EXPERIMENTAL DATA (THE METHOD OF COINCIDENCE OF REACTIONS). Krestnikov, Yu. S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1973. 20p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

A method is presented for the separation of events pertaining to definite but previously unknown events with preliminary assignment of a set of hypotheses. Basically the method is based on the simultaneous use of data from the momentum and energy of particles of any event. This makes it possible to include completely in the study information containing every combination of the experimental data. A verification of the method was made on models and different physically observable reactions. (tr-auth)

22310 PARAMETRIZATION OF A BROAD RESONANCE. Lichtenberg, D. B. (Indiana Univ., Bloomington). pp 23-25 of Baryon Resonances, 73. West Lafayette, IN; Purdue Univ. (1973).

From conference on baryon resonances; West Lafayette, Indiana, USA (20 Apr 1973). See CONF-730477-.

A parametrization of a resonance with background is proposed. In this parametrization, the mass and width parameters entering the formula for the scattering amplitude specify the position of the pole of the amplitude in the complex energy plane. (auth)

22311 CLOSE CORRELATIONS IN THE REGGE MODEL. Mandzhavidze, I. D. (Inst. of Physics, Tbilisi, USSR). JETP Lett. (USSR) (Engl. Transl.); 19: No. 5, 180-181(5 Mar 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 19: No. 5, 314-317(5 Mar 1974).

Starting from the unitarity condition and the conservation law for additive quantum numbers, equations are derived for the cross sections of multiparticle inclusive processes. Within the framework of the theory of complex angular momenta it is shown that, in the approximation in which the particle production is assumed to be independent, the broken symmetry of the exchange degeneracy is restored. The degree of breaking is determined by the value of the Pomeranchuk contribution. (auth)

22312 QUARKHUNTING. Landshoff, P. V. (Cambridge Univ., Eng.). Phys. Bull. (London); 25: 230(Jun 1974).

The evidence for the existence of the constituents of particles, the so called quarks, is considered. The three quarks of the particle spectrum calculations are pictured as playing the role of valence quarks. The proton and neutron each have the same core but have different valence quarks. This picture is strikingly successful in predicting the results of neutrino scattering experiments but the main problem is that the experiments break up the target proton or neutron but so far no quarks have been found among the fragments. Explanations for this are considered. In electron-proton and electron-neutron scattering experiments the virtual photons much prefer to be absorbed by a distinct quark or anti-

quark rather than by one of the mesons and this leads to the problem in understanding recent electron-positron annihilation experiments. These experiments are described and discussed. New accelerators will be required to further these studies and such a facility, EPIC, a 14 GeV + 14 GeV electron-positron colliding beam complex has been proposed. (UK)

22313 THEORY OF PARTICLES WITH INTERNAL DEGREES OF FREEDOM. Photinos, D. J. Kent, OH; Kent State University (1973). 49p. University Microfilms Order No. 74-15,078.

Thesis (Ph.D.).

The basis of a relativistic theory of particles with internal degrees of freedom is set up. Some aspects of the theory are studied in terms of certain simple models. These models appear as generalizations of Dirac's new equation. In particular, Dirac's new equation is generalized to the case of an arbitrary number of spinor internal variables. A natural way of introducing internal symmetries in these models is pointed out. A model based on two spinor variables is studied in some detail and it is found that the first order wave equation has only positive energy solutions and describes a spinless particle. The extensions of the model to include particles with spin are then considered, and the possibility of a kinematical mass-spin spectrum is discussed in this context. The electromagnetic interactions of Dirac's model are studied. It is shown that the impossibility of introducing electromagnetic interactions via minimal substitution can be understood in terms of the position operator. Possible approaches to the general problem of interactions are considered. (LBS)

22314 UNIFIED THEORIES OF ELEMENTARY-PARTICLE INTERACTION. Weinberg, S. Sci. Amer.; 231: No. 1, 50-59 (Jul 1974).

The discussion of unified theories of particle interactions covers the necessity of fields, the intermediate vector boson, tougher identity problems, types of symmetry, appearance and reality, new theories and predictions, and various implications. (JFP)

22315 HIGH ENERGY PHYSICS INDEX. Volume 12, No. 14, 1974. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1974). 77p.

22316 HIGH ENERGY PHYSICS INDEX. Volume 12, No. 13, 1974. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1974). 78p.

22317 HIGH ENERGY PHYSICS INDEX. Volume 12, No. 15, 1974. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1974). 96p.

22318 DEVELOPMENT OF A UNIFIED THEORY OF PARTICLES AND FIELDS. Akulov, N. S. Dokl. Akad. Nauk BSSR; 18: No. 5, 398-401(May 1974). (In Russian).

In recent years (1968–1970) the concept was developed that all matter consists of quarks and antiquarks ϵ^-, ϵ^+ with half integral charge (uniquanta) and that they form pairs (reons) appearing as actual particles. From these reons peptons, hadrons, Zweig-Gell-Mann quarks (corresponding to the Feynmann partons), and vacuum are constructed. On the basis of this quark subproton model the energy and channel spectra and the decay energy of elementary particles were calculated in very good agreement with experimental data. On the basis of practically the same model, called the quark-parton model, Kuti and Veiskopf calculated the pattern of the Kendahl and Panov curves. In this study it was shown that considering the corpuscular-wave nature of the uniquanta and considering that neutrinos, γ quanta, Dirac pairs, and gravitons consist of such quarks–antiquarks, the Weyl, Maxwell, Dirac, and Einstein-Sapar equations can be derived. On the basis of these results it is concluded that all elementary particles are compound and that the existence in nature of their real material components, reons, from which all elementary particles consist, and particularly field quanta can scarcely be doubted. (tr-auth)

22319 POLARIZABILITY OF ELEMENTARY PARTICLE. Terent'ev, M. V. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 19: No. 6, 1298-1312(Jun 1974). (In Russian).

It is shown that the electric polarizability of an elementary particle, contrary to that of an atom or any nonrelativistic system, cannot be represented as a positive sum of dipole excitation cross sections. The noncovariant technique of the old perturbation theory summing up the real intermediate states is not suitable to study the momentum expansions in the relativistic amplitudes. These conclusions are in contradiction with the conventional point of view. The basic results are illustrated by calculations in a model using the vector-meson dominance and PCAC. Some properties of such a model are discussed. The polarizability of K meson is calculated. (auth)

22320 ISOTOPIC SYMMETRY: NONLINEAR AND ALGEBRAIC REALIZATION. Paziashvili, I. V.; Chkareuli, J. L. (Inst. of Physics, Tbilisi, USSR). Yadern. Fiz.; 19: No. 6, 1372-1379(Jun 1974). (In Russian).

The nonlinear and algebraic realization of the isotopic symmetry with linearization on the subgroup of the isospin third projection I_3 is considered. It is shown that the classification of particles with given chirality in the isotopic multiplets is restored. The mass operator turns to be a sum of an isosinglet and of the third projection of an isovector. A general mass formula is obtained for the mass differences in quartets and doublets. It is pointed out that for baryons and pseudoscalar mesons there must be configurations more complicated than octets. The realizations of higher order symmetries are also considered: SU(2) ⊗ SU(2) with linearization on I_3, SU(3) and SU(3) ⊗ SU(3) with linearization on the subgroup I_3 ⊗ Y. Y is a hypercharge. New mass formulas are obtained in SU(3) for mesons and baryons. In particular, there are formulas connecting the isotopic splittings in triplets and doublets. (auth)

22321 ELEMENTS OF A STRUCTURAL THEORY OF ELEMENTARY PARTICLES. P. 3. Muon, Pion, Proton. Bagge, E. (Kiel Univ. (F. R. Germany). Inst. fuer Reine und Angewandte Kernphysik). Atomkernenergie; 23: No. 2, 75-83(1974). (In German).

5 figs.; 4 refs.

Starting with the assumption that there is an internal interaction between the different parts of the particle substratum and consequently also a nucleonic surface tension, an expression for the total energy of an elementary particle as a function of its radius is developed. The unknown parameters of this formula are derived in such a way, that the masses of the proton and of the Σ^+-particle have the character of extremal values, whereas the potential barrier for the relative minimum of energy to produce the stability of the proton, must have a height between the rest energies of muon and pion. The very differential interaction of muons and pions with protons can be understood in this way very easily. Also strangeness finds a simple explanation in this connection. Without any further assumptions the theory gives information about the charge distribution of the proton which is in good agreement with observations. (auth)

22322 APPROXIMATE SOLUTION OF THE GENERALIZED LEE MODEL IN ALL SECTORS. Luchnikov, L. A. Teor. Mat. Fiz.; 19: No. 3, 325-331(Jun 1974). (In Russian).

The interaction of one light relativistic particle with two-level scattering centers is considered. Scattering centers are situated in different points of space. The solution for the case of two centers is considered in detail. The solution is extended to the case of an arbitrary number of centers (the $1N-\theta$ sector). The interaction of two light relativistic particles with two centers situated in different points of space is considered (2V sector). The method of solution is generalized to the case of N light scalar relativistic particles interacting with m centers in excited state and l centers in ground state, situated in different points of space. The results obtained can be useful for derivation of the angular distribution, energy dependence and polarization distribution of induced radiation, in investigating of the induced decay of unstable particles, superradiance and radiance echo. (auth)

22323 GENERATING RELATIONS FOR SPIN AND PARA-FIELD ALGEBRAS. Menon, N. B.; Raghavacharyulu, I. V. V. (Bhabha Atomic Research Centre, Bombay). Teor. Mat. Fiz.; 19: No. 3, 305-309(Jun 1974). (In Russian).

The direct method developed previously which completes the algorithm first suggested by Bhabha, is used to obtain the commutation relations of spin ½, 1 and ⅔ algebras and the parafield algebras of orders 2 and 3. This method makes it almost trivial the procedure to obtain the generating relations of these algebras. Further it shows that Kamefuchi and Takahashi could obtain only a partial set of generating relations for parafield algebras of order 3 by using the method suggested by Madhavrao. (auth)

Electromagnetic

Refer also to abstracts 20716, 22237, 23023, 23053, 23054, and 23059.

22324 (DESY-74/17) COUPLED CHANNEL ANALYSIS OF THE REACTIONS $\gamma\gamma \to \pi\pi$ AND $\gamma\gamma \to K\bar{K}$. Sundermeyer, K. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Apr 1974. 31p. Dep. NTIS (US Sales Only) $4.75.

Thesis. Submitted to Univ., Hamburg.

The processes $\gamma\gamma \to \pi\pi$ and $\gamma\gamma \to K\bar{K}$ are calculated using dispersion relation methods. The integral over the left hand cut is ap-

proximated by exchange of vector mesons. For the right hand cut unitarity is used including two-pion and two-kaon intermediate states. Coupling occurs in the I = 0 S-wave in a form recently given by a Berkeley group (Protopopescu et al.) and in the corresponding D-wave by a K-matrix with poles at the f(1270) and f'(1514). Those cross sections for $\pi\pi$ final states, in which the S-wave contributes, show a very marked spike at the $K\bar{K}$-threshold; those for $\gamma\gamma \rightarrow K\bar{K}$ are of the order of $\gamma\gamma \rightarrow \pi\pi$, depending on the form in which strong interaction is built into the model, and on the $K^*K\gamma$ coupling constant. (auth)

22325 (INIS-MF-1168-2, pp vp, 16p) BREMSSTRAHLUNG IN NUCLEAR PHYSICS: A REVIEW. Nyman, E. 1973.

From Finnish summer school in nuclear physics; Liperi, Finland (11 Jun 1973).

Some theoretical problems in the study of nuclear bremsstrahlung are treated. Electromagnetic radiation from nucleons and nuclei as they collide with other nucleons or nuclei and in particular the reaction $N + N \rightarrow N + N + \gamma$ is studied. (JFP)

22326 (IS-T-645) DEEP INELASTIC eN AND νN SCATTERING: A UNIFIED DESCRIPTION VIA DUAL REGGE POLES AND SU(3). Duke, D. W. (Ames Lab., Iowa (USA)). Jul 1974. Contract W-7405-eng-82. 32p. Dep. NTIS $4.75.

Thesis.

The deep inelastic scattering of electrons and neutrinos off nucleons is studied phenomenologically by means of a model that describes the scattering of weak and electromagnetic currents off nucleons. It is found that one may impose the constraints of Regge behavior, duality, SU(3) symmetry, and current algebra in a model for the structure functions and obtain a very accurate and economical description of the data. This approach demonstrates a remarkable resemblance between the strong interactions of hadrons and their weak and electromagnetic interactions. (auth)

22327 (JINR-E2-7982) TAIL, ZEROS, AND SPACE-LIKE REGION BEHAVIOR OF ELECTROMAGNETIC PION FORM FACTOR. Dubnicka S.; Meshcheryakov, V. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 16p. Dep. NTIS (US Sales Only) $4.00.

Combining the real and imaginary parts of the pion form factor from resonant region, given by simple formula obtained by means of the dispersion relation method, with some special assumptions in asymptotical region and sum rules, the time-like region form factor tail is predicted. Further, the existence of form factor zeros is investigated and on the basis of numerical results one can conclude that the zeros of the pion form factor exist. The predicted space-like region behavior of the form factor by means of the unsubtracted dispersion relation is found to be in an excellent agreement with the existing experimental data. (auth)

22328 (PI-1-223) PHOTO- AND ELECTROPRODUCTION IN THE RESONANCE REGION. Photoproduction Experiments. Fischer, H. M. (Bonn Univ. (F. R. Germany). Physikalisches Inst.). Aug 1973. 37p. (AED-Conf-73-375-015). INIS.

From international symposium on electron and photon interactions at high energies; Bonn, F. R Germany (27 Aug 1973).

39 figs.; 59 refs.

After a short survey of the main features of the resonance behavior of the pion-nucleon system and the formalism which is commonly used for the description of photoproduction of pions in the resonance region, the new experimental achievements during the last two years of photoproduction in the resonance region are reported. The following types of reactions are discussed: single pion photoproduction on nucleons; eta photoproduction on protons; positive kaon photoproduction on protons; the reaction $\gamma + p \rightarrow \pi + \Delta$ (1236); coherent pion photoproduction $\gamma + d \rightarrow \pi^0 + d$; the reactions $\gamma + {}^3He \rightarrow p + d$ and $p + d \rightarrow \gamma + {}^3He$. (GE)

22329 (RL-74-082) FIXED POLE SUMRULE IN PHOTON–PHOTON SCATTERING. Worden, R. P. (Science Research Council, Chilton (UK). Rutherford Lab.). May 1974. 14p. Dep. NTIS (U. S. Sales Only) $4.00.

There is a J = 0 right-signature fixed pole in the amplitude T_{++--} ($\gamma_1\gamma_2 \rightarrow \gamma_1\gamma_2$) for forward elastic photon-photon scattering. When one of the photons is real ($q_1^2 = 0$), the pole residue is an integral of a measurable photon-photon total cross-section. It is shown in the parton model that the residue is $(-1/2\pi^3\Sigma_1^4)$, independent of the other photon's mass-squared q_2^2, and so measures the sum of fourth powers of parton charges. Since no leading Regge poles enter in the sumrule, it can be evaluated more easily than $\gamma p \rightarrow \gamma p$ fixed pole sum rules. (auth)

22330 (RL-74-084) MULTIPARTICLE PRODUCTION AND THE ASYMPTOTIC BEHAVIOUR OF FORM FACTORS. Peccei, R. D. (Science Research Council, Chilton (UK). Rutherford Lab.). Jun 1974. 14p. Dep. NTIS (US Sales Only) $4.00.

Physical arguments are presented, based on local compensation of quantum numbers, which suggest that asymptotically the ratios of the pion form factor to the kaon form factor and to the nucleon form factor (F_1) are in the same proportion as the ratios of hadronic charge exchange amplitudes are to strangeness exchange amplitudes and to baryon exchange amplitudes. It is found that $F_\pi(t)/F_K(t) \sim |t|^{\alpha_\rho - \alpha_{K^*}}$ and $F_\pi(t)/F_1(t) \sim |t|^{\alpha_\rho - \alpha_N}$. Speculations on the asymptotic behavior of the total cross section $e^+e^- \rightarrow$ hadrons are also presented. (auth)

22331 DEEP INELASTIC LEPTON–PROTON SCATTERING AND μ–e UNIVERSALITY. Bilen'kaya, S. I.; Kazarinov, Yu. M.; Lapidus, L. I. (Joint Inst. for Nuclear Research, Dubna, USSR). JETP Lett. (USSR) (Engl. Transl.); 19: No. 1, 51-53(5 Jan 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 19: No. 1, 80-83(5 Jan 1974).

To verify μ-e universality, a joint analysis was performed of the data on deep inelastic μ-p and e-p scattering. It is shown that these data are compatible if the μ-p-scattering cross sections are renormalized. (auth)

22332 COMPTON SCATTERING AND MESON POLARIZABILITIES. Cannata, F. (Univ., Bologna); Zerbini, S.; Mazzanti, P. Lett. Nuovo Cim.; 10: No. 15, 649-653(10 Aug 1974).

The polarizabilities entering in the Compton scattering in the terms of second order in the photon frequencies are studied in the $\lambda\phi^4$ model. The contributions obtained in the Compton scattering are compared with similar terms for $\pi\pi \rightarrow \pi\pi$ and $\pi K \rightarrow \pi K$ scattering. (LBS)

22333 UNIFICATION OF THE WEAK AND ELECTROMAGNETIC INTERACTIONS. Mock, M. K. L. Coral Gables, FL; University of Miami (1973). 71p. University Microfilms Order No. 74-14,342.

Thesis (Ph.D.).

A finite theory unifying the weak and electromagnetic interactions is proposed. To obtain a finite theory, a vector boson with four independent components is postulated. The derivation of this type of boson gives an indication of the origin of the chiral nature of the weak interactions. The photon is shown to be also derivable in terms of chiral projections. The similarity between the photon and this four component vector boson which we call the IVB, implies a relation between the weak and electromagnetic interactions. The unification of these two interactions is based on the assumption that the leptons and the weak-electromagnetic current have the same U(2) or SU(3) internal symmetry. This weak-electromagnetic current does not favor the vector minus axial vector currents, but includes, in addition, the vector plus axial vector currents. Because of this, two representations must be defined, which interchange the roles of the neutral particles. (Diss. Abstr. Int., B)

22334 ANOMALOUS MAGNETIC MOMENT OF THE ELECTRON IN THE MASS OPERATOR FORMALISM. Carroll, R. Ann Arbor, MI; University of Michigan (1973). 93p. University Microfilms Order No. 74-15,683.

Thesis (Ph.D.).

The mass operator formalism is used to calculate the sixth order electron magnetic moment contribution from integrals having zero order photon propagators. Combining our results with those for graphs having loops yields $\mu_{theor.}^{(6)} = 12.9(0.8) \times 10^{-9}$. The uncertainty (1 sigma) is an error estimate on numerical integrations. Using $\alpha^{-1} = 137.03608(26)$ the theoretical value of the anomaly is then $a_e^{theor.} = 1159649.5(2.3)$. This is in reasonable agreement with the experimental value $a_e^{exp.} = 1159656.7(3.5)$, indicating validity of QED to sixth order. (Diss. Abstr. Int., B)

22335 ELECTROMAGNETIC INTERACTIONS. Drees, J. (Gesamthochschule Wuppertal, Ger.). pp 47-91 of Physik 1973. Weinheim, Ger.; Physik Verlag GmnH (1973). (In German).

From 37th physicists conference; Hamburg, F.R. Germany (24 Sep 1973). See CONF-730993-.

The interaction of photons with hadrons is discussed from three aspects: a real photon is divisible or photoproduction and Compton scattering, interaction of a virtual space-like four-momentum photon with nucleons or electron scattering, and annihilation of e^+e^- in hadrons. Before the study of the electromagnetic interactions with hadron materials the nature of the photon and the electromagnetic structure of the hadron are discussed. (JSR)

22336 ELECTROMAGNETIC FORM FACTOR OF THE PION. Brunini, P. L.; Rimondi, F.; Venturi, G. (Univ., Bologna). Lett. Nuovo Cim.; 10: No. 16, 693-700(17 Aug 1974).

A representation for the form factor of the pion is constructed based on a suitable coupling of a photon to pions through an infinite number of equispaced vector mesons. Satisfactory fits to experimental data are obtained. (LBS)

22337 RELYATIVISTSKII ELEKTRON. (Relativistic Electron). Sokolov, A. A.; Ternov, I. M. Moscow; Izdatel'stvo Nauka Glavnaya Redaktsiya Fiziko-Matematicheskoi Literatury (1974). 391p.

The classical and the quantum theories of movement and a study of relativistic electrons are presented. A number of problems are considered, for example, the precise solution of some problems of radiation according to classical electrodynamics, a study of the classical relativistic equation of Dirac–Lorentz with consideration of the forces of radiation friction, and others. Emphasis is on recent developments and practical applications, not only for the micro processes but also for the examination of the movement of ultrarelativistic electron along tracks with a macroscopic radius of curvature (e.g., synchrotronic radiation). Considerable space is devoted to the analysis of similar problems with the use of relativistic quantum equations since without calculation of the quantum effects it is not possible to predict and construct modern cyclic electron accelerators and accessory equipment. (tr-auth)

22338 WAVE FUNCTION OF AN ARBITRARILY POLARIZED ELECTRON. Perov, Yu. S. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 15: No. 1, 113-115(1974). (In Russian).

An expression is presented for the wave function of an electron with energy, momentum and spin directed along a unit vector. The wave functions of a free electron are obtained in a new form more suitable for calculations than previous equations. These formulas for the wave functions were used for calculating the effective cross section of electron-electron and electron-positron scattering. The results of the calculations coincided with those obtained by previous methods, but the volume of calculations was considerably decreased. (SJR)

22339 CALCULATING THE ELECTRIC SCATTERING CROSS-SECTION OF A POLARIZED ELECTRON ON A POLARIZED PARTICLE WITH SPIN 1. Bogush, A. A.; Chan Kouk Chan. (Inst. of Physics, Minsk). Vestsi Akad. Navuk BSSR, Ser. Fiz.-Mat. Navuk; No. 2, 73-81(1974). (In Russian).

With the use of a nonstandard method the calculation of elastic scattering cross sections of an electron on a relativistic particle with a spin of 1, which possesses an internal electromagnetic structure, with initial and final polarizations of the interacting particles being taken into account is presented. A simple scheme of determining form factors of a vector particle is considered. (SJR)

22340 RESOLUTION OF THE APPARENT DISCREPANCY IN THE MAGNETIC FORM FACTOR OF THE DEUTERON. Rand, R. E. (Stanford Univ., CA); Yearian, M. R.; Buchanan, C. D. pp 336-339 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973). See CONF-730642-.

A long-standing discrepancy between theory and the highest momentum-transfer data on the magnetic form factor of the deuteron has been resolved. The source of the discrepancy is found in the original phenomenological fit to the neutron magnetic form factor data available at that time. This fit showed G_{MN}/μ_N greater than G_{MP}/μ_P by about 12% in the momentum transfer region of interest. Data from C.E.A. now show good evidence for the scaling of nucleon form factors in this region, i.e.: $G_{EP} = G_{MP}/\mu_P = G_{MN}/\mu_N$. There is also evidence now that $G_{EN} \neq 0$ as was originally assumed. The theoretical deuteron magnetic form factor has been recalculated using scaling with the dipole nucleon form factor, $G_{EN} = 0.05$ and the Hamada–Johnston model of the deuteron with 7% D-state. The result agrees exceedingly well with all the data up to $q^2 = 14$ fm^{-2}, without the necessity of postulating scattering from meson exchange currents. This is a very satisfactory situation since the electric form factor is equally well described by essentially the same assumptions. However the static magnetic moment anomaly is still not resolved. Rand et al. also reported data on inelastic scattering from the deuteron in the region where the cross section is dominated by the unbound ^1S state. The experimental data are still valid, but the impulse approximation theory with which they were compared is now thought to be incorrect. Riska has shown that the impulse approximation contribution is essentially negligible for $q^2 > 8$ fm^{-2}. Moreover he has calculated the simplest exchange current contributions to the process and has demonstrated that they dominate the theoretical cross section which now agrees extremely well with the highest q^2 data (10 fm^{-2}). Hence backward electron-deuteron scattering is not only sensitive to the magnetic form factor of the neutron, but also provides a powerful tool for examining transition meson exchange currents. (auth)

22341 INELASTIC ELECTRON SCATTERING IN THE SYMMETRIC QUARK MODEL. Ono, S. (Tokyo Univ.). Phys. Rev., D; 9: No. 9, 2670-2676(1 May 1974).

The electroproduction process $ep \rightarrow eN^*$ is studied, using the nonrelativistic symmetric quark model with various binding potentials. The following conclusions are obtained: (i) A modified Woods–Saxon potential $-V_0[(r/b) + 1]/\{(r/b) + \exp[(r-R)/a]\}$ gives the best fit among various quark–quark potentials. (ii) This potential gives values correct for the elastic cross section and the cross section corresponding to the production of the first peak. However, this gives values a little low for the cross sections corresponding to the production of the second and third peaks. (auth)

22342 MAGNETIC MONOPOLES. Wadas, R. (Inst. of Physics, Warsaw). Postepy Fiz.; 25: No. 3, 289-293(1974). (In Polish).

The ideas of Dirac and Schwinger on magnetic monopoles are presented. The methods of their search are listed. Recent developments in experimental results are reviewed. (1 figure) (auth)

Weak

22343 (KHFTI-73-9, pp 28-31) DIRECT FORMATION OF LEPTON PAIRS BY HIGH ENERGY NEUTRINOS ON NUCLEI WITH ACCOUNT OF THE ENERGY SPECTRUM OF THE IHEP NEUTRINO CHANNEL. Makeev, V. V. (Inst. of High Energy Physics, Serpukhov, USSR); Nevskii, P. L.; Nikitin, Yu. P.; Rozhnov, G. V. 1973. (In Russian).

The process of the formation of charged leptons pairs by high energy neutrinos in the electromagnetic field of nucleons and nuclei: $\nu + Z \rightarrow e^+ + \mu^- + \nu_e + Z$ was studied. The results of the calculation of the differential cross section for freon targets were shown graphically. The results of the calculation of the total cross section of the process for different targets were tabulated. (tr-auth)

22344 WEAK AND STRONG DECAYS OF BARYONS. Pakvasa, S. (Hawaii Univ., Honolulu). pp 471-475 of Baryon Resonances, 73. West Lafayette, IN; Purdue Univ. (1973).

From conference on baryon resonances; West Lafayette, Indiana, USA (20 Apr 1973). See CONF-730477-.

Some regularities in nonleptonic weak decays of baryons is recalled, a similar structure for medium strong decays of baryons is suggested. (JFP)

22345 RADIATIVE CORRECTIONS TO LEPTONIC DECAYS OF HADRONS IN RENORMALIZABLE MODELS OF WEAK INTERACTIONS. Vainshtein, A. I.; Khriplovich, I. B. (Inst. of Nuclear Physics, Novosibirsk, USSR). JETP Lett. (USSR) (Engl. Transl.); 19: No. 5, 184-185(5 Mar 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 19: No. 5, 323-325(5 Mar 1974).

It is shown that radiative corrections to the ratio of the vector constants of β and μ decays in renormalizable theories turn out to be essentially the same as in the usual scheme with the intermediate vector boson. Radiative corrections to π_{l2} decays are also considered. (auth)

22346 DISPERSION INEQUALITIES AND EXACT BOUNDS ON THE K_{l3} DECAY PARAMETERS. Shih, I. F. Rochester, NY; University of Rochester (1974). 157p. University Microfilms Order No. 74-14,414.

Thesis (Ph. D.).

In the first chapter a brief review is given of the development of the theory of weak interactions. Then, in Chapter II, the mathematical tools that are required for later calculations are studied. Two kinds of dispersion inequalities are introduced. In the next chapter mainly the K_{l3} decay form factors and parameters are discussed; and the experimental data and some theoretical predictions for them. In Chapter IV, the dispersion inequalities derived in Chapter II are applied to find the bounds of K_{l3} decay parameters. It is found that the bounds disagree with most of the experimental data. It is concluded that the K_{l3} soft-pion theorem may need modification, or the model of Gell-Mann et al., may be incorrect, or the dispersion relation for $\Delta(t)$ may need some subtractions. In the last chapter, some basic assumptions are re-investigated. The bounds are calculated without assuming the validity of unsubtracted dispersion relation for $\Delta(t)$ and without assuming specific SW(3) symmetry breaking model. The so-obtained bounds are still inconsistent with the average experimental data unless for the cases that may need one or more subtractions for the dispersion relation. The method is also applied to the K_{l3} vector form factor $f_+(t)$, and $\lambda_+ \leq 0.059$ is found, where $\lambda_+ \equiv m_\pi^2 f_+'(o)/f_+(o)$. (LBS)

22347 NEUTRAL CURRENTS IN NEUTRINO REACTIONS. Haidt, D. (CERN, Geneva). pp 363-370 of Physik 1973. Weinheim, Ger.; Physik Verlag GmnH (1973). (In German)

From 37th physicists conference; Hamburg, F.R. Germany (24 Sep 1973). See CONF-730993-.

In recent years it has been hypothesized that in neutrino reactions that in addition to the normal reaction in which the neutrino is transformed into a charged lepton (weak charged current)

processes without such a transformation are permitted (weak neutral current). The probability of the experimental verification of this hypothesis is calculated. (JSR)

22348 SUM RULES FOR WEAK PROCESSES. Novikov, V. A. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 19: No. 6, 1356-1363(Jun 1974). (In Russian).

Dispersion relations are applied to weak processes. The Fermi constant G and the coupling constant of neutral currents are expressed in terms of integrals of the cross sections. (auth)

22349 NONMESONIC DECAYS OF LIGHT HYPERNUCLEI AND THE STRUCTURE OF THE WEAK INTERACTION $\Lambda N \to NN$. Kopeliovich, V. B. (Leningrad Inst. of Nuclear Physics). Yadern. Fiz.; 19: No. 6, 1348-1355(Jun 1974). (In Russian).

The probabilities of the nonmesonic decays $^4He_\Lambda$, $^4H_\Lambda$ are expressed through the widths of the decays $\Lambda \to N\pi$ and the density of the nucleon distribution relative to the Λ particle in a hypernucleus. It is shown that the value of the P-odd amplitude $\Lambda N \to NN$ in a nucleus is determined by comparatively large distances ($\tau_{\Lambda N} \sim 1/\mu_\pi$) and weakly depends upon the core in the ΛN potential at small distances. In contrast, the contribution from the P-even amplitude may essentially depend upon the core. The theory agrees with experiment if the contributions from the P-even amplitude of the transition from the $^3S_1$ state and $^1S_0$ state of the ΛN system are several times suppressed due to the core. (auth)

22350 EMISSION OF HIGH ENERGY PHOTONS FOLLOWING THE $\nu(\bar{\nu})$ SCATTERING ON HADRONS. Frankfurt, L. L.; Sherman V. E. (Leningrad Inst. of Nuclear Physics). Yadern. Fiz.; 19: No. 6, 1338-1347(Jun 1974). (In Russian).

It is shown provided the Gell-Mann, Dashen, Fubini sum rules are valid that the amplitude of the process $\bar{\nu} + p \to l^+ + n + \gamma$ may be calculated with an accuracy up to a power of the photon energy. An expression for the cross section, valid also at high photon transversal momenta, is obtained. The effect of the W meson on the amplitude and on the cross sections of the above mentioned process is considered. (auth)

22351 FORM FACTORS AND PRODUCTION CROSS SECTIONS OF BARYON RESONANCES IN νN INTERACTIONS. Bugaev, E. V. (Inst. of Nuclear Research, Moscow). Yadern. Fiz.; 19: No. 6, 1327-1337(Jun 1974). (In Russian).

A general expression is obtained for the production cross section of baryon resonances with an arbitrary spin in νN interaction. The cross section is parametrized using the multipole-like transition form factors. The formula for the form factors is derived in the framework of nonrelativistic symmetrical quark model. The model is used to calculate numerically the differential and total cross sections for a number of resonances. The predictions of the quark model are compared with previous results obtained by a different way. (auth)

22352 EXCHANGE CURRENTS IN QUASIELASTIC INTERACTION OF NEUTRINO WITH NUCLEI. Bugaev, E. V. (Inst. of Nuclear Research, Moscow). Yadern. Fiz.; 19: No. 6, 1322-1326 (Jun 1974). (In Russian).

The exchange current correction (i.e., the correction caused by two-nucleon terms in the Hamiltonian of weak lepton-nuclear interaction) is calculated for the cross section of neutrino quasielastic scattering on nuclei. The explicit form of the two-nucleon operators is found by using some model assumptions and the Adler–Dothan low energy theorem for weak currents. The numerical calculations are made for the simplest case–the neutrino scattering on ^4He. (auth)

22353 NEUTRINOS IN THE UNIVERSE. de Graaf, T. Vistas Astron.; 15: 161-181(1973).

The relations which exist between the properties of the neutrino and the behavior of the universe as a whole. The hot big bang theory describes the thermal history of the universe, during which the lepton era was particularly important with regard to weak interaction physics and the predicted neutrino processes. Possible modifications of the theory of weak interactions change these processes and the cosmological role of the neutrinos. Several possible estimates and upper limit values are given for the neutrino energy density, which can be obtained from the cosmological model and experimental data. (auth) (IAA)

22354 PARITY-NONCONSERVING NUCLEAR INTERACTION AND THE SECOND CLASS AXIAL CURRENT. Chemtob, M. (CEN de Saclay, Gif-sur-Yvette, France); Desplanques, B. pp 67-69 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973). See CONF-730642-.

The two-pion exchange parity non conserving nucleon–nucleon amplitude is examined in the covariant approach using dispersion theory. Results are given for the pseudo-scalar potentials with isospin selection rules $\Delta T = 0,1$ and 2. It is confirmed that a sizeable contribution to $\Delta T = 1$ potentials could occur from the second class component of the axial current in Cabibbo theory of weak interactions. (auth)

Strong (General)

Refer also to abstract 23061.

22355 (CONF-730804-P5, pp 3354-3374) HIGH-ENERGY HADRONIC REACTIONS. Frazer, W. R. (Univ. of California, San Diego, La Jolla). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 5.

An attempt is made to review the NAL-ISR results with emphasis on concepts such as scaling and isobar-pionization models that can be applied to the high-statistic multivariable experimental distributions of cosmic-ray research. (CES)

22356 (COO-1545-141) HIGGS TYPE LAGRANGIAN AND DUAL STRINGS. Arik, M.; Tanaka, K. (Ohio State Univ., Columbus (USA). Dept. of Physics). 1973. Contract AT(11-1)-1545. 16p. Dep. NTIS $4.00.

A nonlinear Born Infeld type of Lagrangian which yields the Maxwell and Higgs Lagrangian in the weak limit and the dual string model in the strong limit is studied. In particular, it is argued that the limit in which the string-like solution is obtained is a super quantum-mechanical limit. The effect of the contributions which become zero in this limit is discussed and an approximate vortex line solution is obtained. (auth)

22357 (ITP-74-51E) ASYMPTOTICS OF TOTAL CROSS SECTIONS AND ULTIMATE TEMPERATURE OF HADRONIC SYSTEMS. Enkovskii, L. L.; Trushevskii, A. A. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1974. 22p. Dep. NTIS (US Sales Only) $4.25.

Within the framework of the S–matrix formulation of statistical mechanics the connection between the properties of the hadronic system and the asymptotic behavior of total cross sections is studied; it is found that the hadronic system has an ultimate temperature if the total cross section decreases or it tends to a constant value from above, while the indefinite growth of the total cross section or its approach to a limit from below means that the hadronic system allows an unlimited heating. Also, the density of states of the hadronic matter, the equation of state of a hadronic system, and the multiplicity of produced particles are obtained. (4 figures) (auth)

22358 (LBL-3014) PERIPHERAL THRESHOLDS AND REGGE ASYMPTOTIC EXPANSIONS. Chew, G. F.; Koplik, J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 10 May 1974. Contract W-7405-eng-48. 30p. (CONF-740713-15). Dep. NTIS $4.50.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

Multiperipheral models are used to show how the Regge expansion, while lacking threshold branch points, may nevertheless approximate the localized physical effects of "peripheral" thresholds. Examples are given to demonstrate that a single pair of complex poles is capable of representing even the lowest inelastic thresholds in both total and single-particle inclusive cross sections. The Regge mechanism that allows the position of a threshold to depend sensibly on the masses of incoming and outgoing particles is elucidated. (auth)

22359 NEW CONSERVATION LAWS IN STRONG INTERACTIONS IN THE LADDER U(6,6)-SUMMARY. Vaklev, I. S.; Drenska, S. B.; Ivanov, M. I.; Nikolov, A. V. Teor. Mat. Fiz.; 20: No. 1, 78-84(Jul 1974). (In Russian).

A class of strong interactions specified by the presence of K-mesons in all reactions and decays is considered. It is proved that in these processes, besides the traditional conservation laws, two new laws are also valid. Namely, N^2 and $(S + l)^2$ are conserved (N is the normal spin, S the strange spin, l the orbital moment). The research is done with the aid of the classification scheme for hadrons proposed by the authors in previous papers. Moreover, on the base of the same scheme an additional parity is introduced, conserved in all strong interactions. (auth)

22360 COLOR QUARKS, OCTONIONS, AND THE POINCARE GROUP. Guenaydin, M. New Haven; Yale University (1973). 142p. University Microfilms Order No. 74-16,581.

Thesis (Ph.D.).

The octonionic representations of the Poincare group are studied.

To achieve this end an octonionic Hilbert space with complex scalar products is constructed. This Hilbert space has the gauge invariance group U(4) and the algebraic automorphism group SU(3). The unitary representations of the Poincare group over this Hilbert space are then constructed and it is shown that the underlying octonion algebra introduces certain superselection rules for the tensor product states over this space. By interpreting the automorphism group SU(3) as a color SU(3) it is found that only color singlet and color triplet states are allowed in our Hilbert space. By taking a colored unitary spin triplet of quarks it is shown that the only allowed colorless product states correspond to the observed unitary spin multiplets, thus agreeing with the color quark scheme of Gell-Mann. Further it is shown that the Von Neumann theory of observable states implies that the non-associative and non-commutative components of the state vectors in our Hilbert space, which carry colors, are not observable. An algebraic system, namely the exceptional Jordan algebra T_3^4 is found, which incorporates both a unitary spin SU(3) and a color SU(3) and in which all the unitary spin triplets carry colors. By taking as the unitary spin triplets the nine Fermi-Dirac quarks of Gell-Mann it is shown that only the colorless pseudoscalar meson singlet and octet, vector meson singlet and octet, baryon octet ($s = \frac{1}{2}$) and baryon decuplet ($s = \frac{3}{2}$) and the states obtained by their combinations can be observables. This result agrees with the experimentally observed unitary spin multiplets. (Diss. Abstr. Int., B)

22361 MNOZHESTVENNYE PROTSESSY PRI VYSOKIKH ENERGIYAKH. (Multiple Processes at High Energy). Murzin, V. S.; Sarycheva, L. I. Moscow; Atomizdat (1974). 368p.

Experimental material on questions of strong inelastic interactions of particles obtain at energies higher than several GeV in accelerators and in cosmic rays were systematized. Some new experimental methods and methods for the kinematic and dynamic analysis of experimental data are examined. The experimental results are compared with theoretical models. Some hypothetical processes anticipated in the area of superhigh energy are discussed. (tr-auth)

22362 LORENTZ-INVARIANT EXPANSION OF THE SCATTERING AMPLITUDE FOR PARTICLES OF ANY SPIN. Aneva, B. L. (Inst. for Nuclear Research and Nuclear Energies, Sofia); Hadjiivanov, L. K.; Mavrodiev, S. Ch. Fizika (Zagreb); 6: No. 1, 9-28(May 1974).

The Lorentz-invariant expansion of the scattering amplitude for particles of arbitrary spin is given explicitly. The conditions for P, T, and CPT invariance are also given. πN and NN scatterings are considered as an illustration of the method. (auth)

Strong (Baryon No. = 0)

22363 (ITF-74-53P) SIMPLE ANALYTIC MODEL FOR BOSON REGGE TRAJECTORIES. Bugrii, A. I.; Kobylinskii, N. A. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1974. 20p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

A simple analytic model for Regge trajectories based on the so-called tachyon approximation is suggested. The trajectories have square-root asymptotic behaviour and square-root branch points corresponding to thresholds. The nonstrange meson trajectories are considered in detail. The model accounting the first π-meson $K\bar{K}$ and $N\bar{N}$ thresholds fits resonance region data and is in agreement with scattering region data. It also predicts the number of meson resonances, their maximal masses and explains the exotic channels. (auth)

22364 (RL-74-079) SUM RULES FOR INVERSE $\pi\pi$ SCATTERING AMPLITUDES. Common, A. K.; Pennington, M. R. (Science Research Council, Chilton (UK). Rutherford Lab.). May 1974. 15p. Dep. NTIS (U. S. Sales Only) $4.00.

Sum rules based on crossing symmetry, analyticity and positivity are derived for the inverse of $\pi\pi$ scattering amplitudes. Their importance lies in the fact that, unlike such sum rules for the amplitude itself, these for the inverse impose constraints on the s and p wave amplitudes. The results of testing recent phenomenological solutions to Roy's equations with $\pi^0\pi^0$ sum rules are given. (auth)

22365 HADRONIC DECAY PROCESSES AND THE TRANSFORMATION FROM CURRENT TO CONSTITUENT QUARKS. Gilman, F. J. (Stanford Univ., CA). pp 441-454 of Baryon Resonances, 73. West Lafayette, IN; Purdue Univ. (1973).

From conference on baryon resonances; West Lafayette, Indiana, USA (20 Apr 1973). See CONF-730477-.

Theoretical work on the connection between the algebras associated with current and constituent quarks is reviewed. Tests of the proposed connection are presented using both the magnitudes and signs of amplitudes for pionic transitions between hadrons. (auth)

22366 DUAL ABSORPTIVE MODEL CALCULATION FOR THE REACTION $\bar{p}p \to \Delta^{3+}(1236)\Delta^{3+}(1236)$. Rafique, M.; Bhatti, S. (Punjab Univ., Lahore, Pakistan). Lett. Nuovo Cim.; 10: No. 15, 641-644(10 Aug 1974).

A quantitative explanation for the differential cross section of $\bar{p}p \to \bar{\Delta}\Delta$ at 5.7 GeV/c and 12.0 GeV/c and for the total cross section at 3.6, 5.7, 7.0 and 12.0 GeV/c is given on the basis of the modified dual absorption model. (LBS)

22367 DETERMINATION OF A MINIMAL MESON SPECTRUM COMPATIBLE WITH SEMI-LOCAL DUALITY. de Crombrugghe, M. (Catholic Univ., Louvain, Belgium). Ann. Soc. Sci. Brux. Ser. I; 88: No. 2, 205-218(10 Jun 1974). (In French).

Using kinematical constraints which follow from angular momentum conservation in the forward direction (t = 0), and assuming that the spin structure of scattering amplitudes is given by the exchange of a leading, factorizable, exchange degenerate trajectory ($\rho - f_0$), one obtains from duality a system of homogeneous equations between resonance couplings in the direct channel. This scheme is applied to scattering processes involving only pseudoscalar and/or vector mesons: with duality interpreted in a "semi-local" sense (i.e., only one resonance per Regge trajectory contributes to the sum rule), the solution of the system of homogeneous equations leads to a minimal spectrum of meson resonances. (auth)

22368 OFF MASS SHELL PI-PI SCATTERING IN A COUPLED CHANNEL K-MATRIX FORMULATIONS. Loos, L. L. Lafayette, IN; Purdue University (1973). 97p. University Microfilms Order No. 74-15,196.

Thesis (Ph.D.).

The present $\pi\pi$ scattering data is reviewed, especially the structure near the $K\bar{K}$ threshold. Different "explanations" of this phenomena are discussed. The four point Veneziano amplitude is used in a coupled two channel K-matrix formulation to obtain a prediction for $\pi\pi \to \pi\pi$ and $\pi\pi \to K\bar{K}$ scattering. In particular, the amplitude is continued off the pion mass shell to obtain predictions for the experimental data before extrapolations. Different forms for the real part of the phase space density matrix element in the model are used. The parameters are chosen to fit the physical rho and f mesons and then phase shifts, inelasticities, cross sections, and $\langle Y_1^0 \rangle$ moments are calculated and compared with the data. Although the model does not always fit the data well, it reproduces many of the features of the data. (Diss. Abstr. Int., B)

Strong (Baryon No. = 1)

Refer also to abstracts 22252, 22270, and 22286.

22369 (KFKI-74-31) SCALING TEST IN π^-p SEMI-INCLUSIVE REACTIONS. Krasznovszky, S.; Ponta, T. (Kozponti Fizikai Kutato Intezet, Budapest (Hungary)). 1974. 8p. Dep. NTIS (US Sales Only) $4.00.

The scaling properties of the semi-inclusive reaction $\pi^-p \to \pi^{-+}$ (n-1) charged + neutrals at 7.5, 21, and 40 GeV/c incident π^- momenta are presented. The distributions of the normalized Lorentz invariant single-particle semi-inclusive differential cross sections (h-functions) in the Feynman variable x for the outgoing π^-particles indicate the presence of a limited scaling. The sum rule concerning the cross sections of the studied reaction was also tested at 21 and 40 GeV/c. (auth)

22370 (KHFTI-73-9, pp 18-19) MULTIPLICITY OF CHARGED PARTICLES PRODUCED IN π-MESON INTERACTIONS WITH CARBON AT THE MOMENTUM 40 GeV/c. Eliseev, S. M. (Joint Inst. for Nuclear Research, Dubna, USSR). 1973. (In Russian).

By the Monte Carlo method calculations were made of the distribution according to multiplicity of charged particles produced in π-N interactions at energies of 40 GeV. The independent particle model (the Fermi gas model) was used as a nuclear model. The calculation results were compared with experimental data. (tr-auth)

22371 (LBL-3002) MULTIPLICITY BEHAVIOR OF $\pi^-p \to$ pX: A MULTIPERIPHERAL MODEL DESCRIPTION. Chan, C. F.; Winkelmann, F. C. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 18 Jun 1974. Contract W-7405-Eng-48. 13p. (CONF-740713-14). Dep. NTIS $4.00.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

For the inclusive reaction $\pi^-p \to pX$, the average charged multiplicity $\langle n \rangle$ of the system X as a function of missing mass M^2 and momentum transfer t is studied in terms of a multiperipheral model. For $M^2 \geq 20$ GeV^2 (above the low-mass pion diffraction region) and for $|t| \leq 1$ GeV^2, the model is found to be in good agreement with data at 205 GeV/c, which show $\langle n(M^2,t) \rangle \sim$

ln M^2 for fixed t, and $\langle n(M^2,t)\rangle$ only weakly dependent on t for fixed M^2. Further experimental and theoretical investigation is suggested. (auth)

22372 BARYON RESONANCES, 73. Conference Held at West Lafayettc, Indiana, April 20–21, 1973. West Lafayette, IN; Purdue University (1973). 488p. (CONF-730477-).

The conference included 43 papers. Separate abstracts were prepared for each paper. (JFP)

For abstracts of individual papers see: 22231, 22247–22255, 22284–22294, 22310, 22344, 22365, 22373–22388, and 22424–22426.

22373 EMPIRICAL RULE FOR RESONANCES IN $\pi N \rightarrow \pi\Delta$ AND QUARK DYNAMICS. York, M. J. (Birmingham Univ., Eng.). pp 27-30 of Baryon Resonances, 73. West Lafayette, IN; Purdue Univ. (1973).

From conference on baryon resonances; West Lafayette, Indiana, USA (20 Apr 1973). See CONF-730477-.

It is shown that the rule $l_{\pi\Delta} = l_{\pi N}$ for prominent resonances in the reaction $\pi N \rightarrow \pi\Delta$ for the dynamically preferred $\pi\Delta$ orbital state follows from the quark model if one makes simple assumptions concerning the quark dynamics. These assumptions also give the $\Delta L_z = 1$ rule which breaks $SU(6)_W$. (JFP)

22374 NUCLEON RESONANCES. Moorhouse, R. G. (Univ. of Glasgow). pp 31-52 of Baryon Resonances, 73. West Lafayette, IN; Purdue Univ. (1973).

From conference on baryon resonances; West Lafayette, Indiana, USA (20 Apr 1973). See CONF-730477-.

A review of the present status of nucleon resonances, from partial wave analyses of pion-nucleon scattering and associated production, is given. (auth)

22375 ANALYSIS OF $\pi N \rightarrow \pi\pi N$ AND COUPLED CHANNEL ANALYSES OF πN REACTIONS. Cashmore, R. J. (Stanford Univ., CA). pp 53-80 of Baryon Resonances, 73. West Lafayette, IN; Purdue Univ. (1973).

From conference on baryon resonances; West Lafayette, Indiana, USA (20 Apr 1973). See CONF-730477-.

The status of partial wave analyses of $\pi N \rightarrow \pi\pi N$ in the energy range $1300 < E < 2000$ MeV is reviewed. In the majority of partial waves the total πN inelasticity is accounted for and the inelastic decay channels of many resonances are observed. In total 23 resonance couplings to the states $\pi\Delta$, $N\rho$, $N\epsilon$ are measured both in magnitude and sign. The D_{13} state in the region of 1700 MeV is unambiguously observed while there is a conspicuous absence of P_{33} states below 2000 MeV. Coupled channel analyses of these partial wave amplitudes, exploiting unitarity to the fullest extent, were performed resulting in pole positions and residues for all resonant states with mass <1900 MeV. Finally the different methods of estimating resonance parameters are discussed, and the results contrasted. (auth)

22376 PARTIAL WAVE ANALYSES OF $\pi^+p \rightarrow \pi^0\pi^+p$ AND $K^+\Sigma^+$ AT 1.28 TO 1.84 GeV/c. Kernan, A. (California Univ., Riverside); Fung, S. Y.; Mehtani, U.; Williamson, Y.; Michael, W.; Kalmus, G. B.; Birge, R. W. pp 113-119 of Baryon Resonances, 73. West Lafayette, IN; Purdue Univ. (1973).

From conference on baryon resonances; West Lafayette, Indiana, USA (20 Apr 1973). See CONF-730477-.

Partial wave analyses of $\pi^+p \rightarrow \pi^0\pi^+p$ and $K^+\Sigma^+$ have yielded values for the s-channel resonance parameters in the $\pi^0\Delta^{++}(1236)$ and $K^+\Sigma^+$ final states, and information on the t-channel exchanges leading to the ρ^+p final state. The analysis of $\pi^0\Delta^{++}(1236)$ also yields confirmation of a prediction, based on the duality hypothesis, that the $\Delta(1236)$ will be in a pure helicity $\frac{3}{2}$ state. (auth)

22377 DUAL PATTERNS IN BARYON RESONANCE DATA. Odorico, R. (Argonne National Lab., IL). pp 135-147 of Baryon Resonances, 73. West Lafayette, IN; Purdue Univ. (1973).

From conference on baryon resonances; West Lafayette, Indiana, USA (20 Apr 1973). See CONF-730477-.

Two types of regularity, characteristic of dual models, which are exhibited by data involving the formation of baryon resonances in two-body processes are discussed. One of them concerns the energy dependence of the shape of the angular distribution, and the other the systematics of partial widths of peripheral resonances. The two types of regularity are strictly interconnected and, together, offer concrete indications about what a realistic dual model should look like in amplitudes corresponding to simple spin configurations. (auth)

22378 SIMULTANEOUS FIT TO ENERGY AND ANGLE DEPENDENCE OF K^+p SCATTERING DATA. Cutkosky, R. E. (Carnegie-Mellon Univ., Pittsburgh); Hicks, H. R.; Kelly, R. L.; Sandusky, J.; Shih, C. C.; Johnson, P.; Miller, R. C.; Yokosawa, A. pp 175-178 of Baryon Resonances, 73. West Lafayette, IN; Purdue Univ. (1973).

From conference on baryon resonances; West Lafayette, Indiana, USA (20 Apr 1973). See CONF-730477-.

The angular dependence of the amplitudes at fixed energy was parametrized by the accelerated convergence expansion method. The energy dependence is incorporated through a partial wave dispersion relation interpolation procedure, using expansions in regulated-norm optimal bases in each partial wave which enters as a search parameter in the single energy fits. (JFP)

22379 PHASE SHIFT ANALYSES OF THE K^+–NUCLEON INTERACTION IN THE I = 0 STATE UP TO 1.5 GeV/c. pp 199-219 of Baryon Resonances, 73. West Lafayette, IN; Purdue Univ. (1973).

From conference on baryon resonances; West Lafayette, Indiana, USA (20 Apr 1973). See CONF-730477-.

Energy-dependent and energy-independent phase shift analyses were carried out for the I = 0 state in K^+N scattering. The energy-dependent analysis covers the momentum range 0.60 to 1.50 GeV/c while the energy-independent analyses cover the range 0.37 to 1.50 GeV/c. Two solutions are preferred showing a counter-clockwise circle in the Argand diagram of the $P_{_{\S}}$ amplitude with the maximum around 1 GeV/c. (auth)

22380 EXOTIC RESONANCES IN THE I = 0 K–N SYSTEM. Aaron, R. (Northeastern Univ., Boston). pp 221-232 of Baryon Resonances, 73. West Lafayette, IN; Purdue Univ. (1973).

From conference on baryon resonances; West Lafayette, Indiana, USA (20 Apr 1973). See CONF-730477-.

It is shown that I = 0 KN resonances exist because phase shift analyses indicate this and because a reliable theory reproduces the results of the phase shift analyses, and in this theory the appropriate resonant partial wave amplitudes have second sheet poles. (JFP)

22381 QUARK-EYE VIEW OF EXOTICS. Faiman, D. (CERN, Geneva). pp 233-238 of Baryon Resonances, 73. West Lafayette, IN; Purdue Univ. (1973).

From conference on baryon resonances; West Lafayette, Indiana, USA (20 Apr 1973). See CONF-730477-.

Simple quark model arguments lead to the conclusion that the outcome of a $\pi^+p \rightarrow$ forward Λ missing mass experiment is likely to yield valuable information as to how, if at all, exotic baryons are to be detected. The appearance of K^{++} resonances would suggest that KN formation experiments are unlikely to yield Z^* resonances, whereas the apparent absence of exotic mesons would lend plausibility to certain types of resonant solutions in KN phase shift analyses. (auth)

22382 REVIEW OF DATA AND PARTIAL-WAVE ANALYSES IN THE ENERGY RANGE 1530 TO 1900 MeV. Plane, D. E. (Max-Planck-Institut, Munich). pp 253-282 of Baryon Resonances, 73. West Lafayette, IN; Purdue Univ. (1973).

From conference on baryon resonances; West Lafayette, Indiana, USA (20 Apr 1973). See CONF-730477-.

A review of results of partial-wave analyses in the energy range 1530 to 1900 MeV is presented. Particular attention is focussed on the consistency of resonance parameters reported by different analyses. A summary of available data is also given, together with a comparison of new results with those already reported. (auth)

22383 MEASUREMENT OF MASSES AND WIDTHS IN THE BARYON DECUPLET. Baltay, C. (Columbia Univ., New York); Bridgewater, A.; Cooper, W. A.; Gerschwin, L. K.; Habibi, M.; Kalelkar, M.; Yeh, N. pp 387-392 of Baryon Resonances, 73. West Lafayette, IN; Purdue Univ. (1973).

From conference on baryon resonances; West Lafayette, Indiana, USA (20 Apr 1973). See CONF-730477-.

A precision measurement of the masses, widths, and mass differences of the $Y^*(1385)$ and the $\Xi^*(1530)$ was carried out. These new results, combined with the previous determinations of the masses and widths of the $\Delta(1238)$ and the $\Omega(1672)$, are compared with SU(3) predictions for the baryon decuplet. (auth)

22384 BARYON SPECTROSCOPY WITH THE QUARK MODEL. Dalitz, R. H. (Oxford Univ.). pp 393-416 of Baryon Resonances, 73. West Lafayette, IN; Purdue Univ. (1973).

From conference on baryon resonances; West Lafayette, Indiana, USA (20 Apr 1973). See CONF-730477-.

Attention is given to the simplest possible quark model for baryons. Mass values for the various baryon states are calculated using this model. (JFP)

22385 STATUS OF THE INTERPRETATION OF THE $\Lambda(1405)$. Shaw, G. L. (California Univ., Irvine). pp 417-426 of Baryon Resonances, 73. West Lafayette, IN; Purdue Univ. (1973).

From conference on baryon resonances; West Lafayette, Indiana, USA (20 Apr 1973). See CONF-730477-.

The review of the $\Lambda(1405)$ covers the energy dependence of the

SO 1 partial wave and a summary of recent papers. It is concluded that the present low energy $\bar{K}N$ data cannot be used to decide between the two dynamical models for this resonance and that the situation will not change substantially. Preference is shown for the quark model interpretation that this resonance is a number of (70,1-) and correspondingly lies on a linearly rising Regge trajectory with slope (1). (JFP)

22386 $SU(6)_W$ FOR BARYON DECAY WIDTHS. Faiman, D. (CERN, Geneva). pp 427-440 of Baryon Resonances, 73. West Lafayette, IN; Purdue Univ. (1973).

From conference on baryon resonances; West Lafayette, Indiana, USA (20 Apr 1973). See CONF-730477-.

A critical discussion is presented of the extent to which $SU(6)_W \times O(2)L_z$ is a successful symmetry for organizing and interrelating their various partial widths. Restriction is made to some general features of how the symmetry is used, what pitfalls would be looked for, the extent to which the predictions are successful and where they fall down. (JFP)

22387 K-MATRIX POLES AND THE $Y_0^*(1405)$. Dobson, P. N. Jr. (Hawaii Univ., Honolulu). pp 463-464 of Baryon Resonances, 73. West Lafayette, IN; Purdue Univ. (1973).

From conference on baryon resonances; West Lafayette, Indiana, USA (20 Apr 1973). See CONF-730477-.

A recent fit to the data using a parameterization of the K matrix with no constant term for the $\Lambda(1405)$ resonance. (JFP)

22388 WIDTHS AND ELASTICITIES OF MESON–BARYON RESONANCES. Lichtenberg, D. B. (Indiana Univ., Bloomington). pp 465-469 of Baryon Resonances, 73. West Lafayette, IN; Purdue Univ. (1973).

From conference on baryon resonances; West Lafayette, Indiana, USA (20 Apr 1973). See CONF-730477-.

Empirical regularities are found in the widths and elasticities of the baryon resonances as functions of their masses. (auth)

22389 NEW RESULTS ON K^+n ELASTIC DIFFERENTIAL CROSS SECTION BETWEEN 0.64 AND 1.51 GeV/c AND I = 0 PHASE SHIFT ANALYSIS. Bologna-Glasgow-Roma-Trieste Collaboration BGRT. pp 165-184 of Proceedings of the Triangle Seminar. Haberler, P. L. F. (ed.). Vienna; Institut fuer Hochenergiephysik, Oesterreichische Akademie der Wissenschaften (1972).

From triangle seminar on experimental high energy physics; Vienna, Austria (9 Oct 1972). See CONF-7210121–.

The necessity of more data, in order to resolve ambiguities in the p.s.a. of the I = 0 part of the K^+-nucleon system is emphasized. Problems and results of a measurement of the K^+n elastic differential cross-section are described. (auth)

22390 BARYON COUPLINGS IN A SERBER-TYPE H.O. MODEL. Mitra, A. N. (Univ. of Delhi); Sutapa Sen. Lett. Nuovo Cim.; 10: No. 16, 685-688(17 Aug 1974).

The coupling scheme for baryons in the framework of a Serber-type h.o. model is outlined. In order to illustrate the possibilities of testing some of the broad coupling predictions of this model, a few sum rules involving the couplings of 70 Λ states are presented. (LBS)

22391 SINGLE PARTICLE SPECTRA FROM PION–PROTON SCATTERING AT 10 AND 15.5 GeV/c. Heller, K. J. Seattle; University of Washington (1974). 224p. University Microfilms Order No. 74-15,515.

Thesis (Ph.D.).

A single arm spectrometer employing both multiwire proportional chambers and wire spark chambers was used to measure single particle distributions for the inclusive processes $\pi + p \rightarrow \pi +$ anything and $\pi + p \rightarrow p +$ anything. Data was taken for all pion charge combinations at incident pion momenta of 10 GeV/c and 15.5 GeV/c. The invariant double differential cross sections for the above reactions are presented over the kinematic range $0 \leq x \leq 0.5$, $0.18\ \text{GeV/c} \leq p_T \leq 0.9\ \text{GeV/c}$ for secondary pions and $-0.3 \leq x \leq 0.6$, $0.18\ \text{GeV/c} \leq p_T \leq 0.9\ \text{GeV/c}$ for secondary protons. (Diss. Abstr. Int., B)

22392 COULOMB CORRECTIONS TO π^+p ELASTIC SCATTERING. Zimmermann, H. (Univ., Schoenberggasse, Zurich). Helv. Phys. Acta; 47: 130-136(1974).

Coulomb corrections to π^+p phase shifts below 300 MeV are calculated in a simple nonrelativistic potential model. Comparison with more refined calculations justifies this simple treatment of the Coulomb barrier effect. The dependence of the Coulomb corrections on the use of different form factors in the Coulomb amplitudes is shown. (1 figure, 3 tables) (auth)

22393 DIFFRACTIVE DISSOCIATION OF PIONS AND NEUTRONS AT 15 GeV/c IN π^-d INTERACTIONS. Bastien, P. L. (Univ. of Washington, Seattle); Dunn, L. A.; Harris, R.; Lubatti, H. J.; Moriyasu, K.; Podolsky, W. J.; Bingham, H. H.; Chew, D. M.; Fretter, W. B.; Graves, W. R. pp 143-146 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973). See CONF-730642-.

Preliminary results are presented on the diffractive dissociation of pions and neutrons into multiparticle final states. The data are obtained from π^-d interactions at 15 GeV/c in the SLAC 82-inch bubble chamber and are measured on the University of Washington's PEPR system. Pion dissociation is studied in the reaction $\pi^-d \rightarrow \pi^-\pi^-\pi^+d$. The well-known A_1 ($\rho\pi$) and A_3 ($f\pi$) diffractive enhancements are clearly observed in the 3π mass spectrum. In addition, there is an indication of a mass peak at approximately 1.9 GeV. This new enhancement, called the A_4 ($g\pi$), is the first experimental observation of pion dissociation into a $g\pi$ threshold state. Diffractive dissociation of neutrons is observed in the reaction $\pi^-d \rightarrow \pi^-\pi^-pp$. Evidence for two different production mechanisms is seen in the momentum transfer distribution. The low mass $p\pi^-$ events are extremely peripheral (exp (15t')) while the higher masses have a more normal exp (6t') distribution. The low mass behavior is consistent with neutron diffractive dissociation. This conclusion is also supported by the $p\pi^-$ angular distributions. There is some evidence for production of the known N^* resonances but only for $t' \geq 0.1\ (\text{GeV/c})^2$. (auth)

22394 REGGE POLE PLUS BACKGROUND MODEL OF BACKWARD πp SCATTERING. Kogitz, S.; Logan, R. L. (Univ. of Toronto). Can. J. Phys.; 52: No. 13, 1155-1159(1 Jul 1974).

A model of backward π^+p, π^-p, and π^-p charge exchange scattering consistent with the earlier approach to forward π^-p charge exchange and backward π^+p is presented. Two body differential cross section data are considered which exhibit a dip–bump structure as well as nonzero polarization. This is explained in terms of a dominant Regge pole vanishing at the dip accompanied by a background. The background is primarily responsible for the large u behavior of the cross section which includes the rise after the dip. It is assumed that the presence of nonzero polarization dictates this behavior. The $I = 3/2$ amplitude in π^-p backwards is isolated and the $I = 1/2$ amplitude is determined from π^+p backwards. A prediction for $\pi^-p \rightarrow n\pi^0$ follows. (auth)

Strong (Baryon No. ≥ 2)

Refer also to abstracts 22437, 22583, 22598, 22729, 22936, and 22937.

22395 (CERN-74-8, pp 1-40) NUCLEON–NUCLEON SCATTERING: PRESENT STATE AND FUTURE PROSPECTS. Edgington, J. A. (Queen Mary Coll., London). 10 Apr 1974.

From intermediate energy physics meeting; Zuoz, Switzerland (13 Apr 1973).

The review is restricted to the energy region accessible to the new accelerators, that is, 200 to 800 MeV and covers the capabilities of the new facilities, the phenomenology of elastic scattering, energy dependence, charge independence, charge asymmetry, dynamics, symmetries of the strong interaction, parity conservation, T invariance, off-shell amplitudes and bremsstrahlung. Also reviewed are np capture, pion production, and the deuteron. (JFP)

22396 (IFVE-SEF-72-106) GLAUBER CORRECTIONS ACCOUNTING FOR INELASTIC SCREENING AND CALCULATION OF pn, $\bar{p}n$, AND K^+n TOTAL CROSS SECTIONS. Anisovich, V. V.; Stoyanova, D. A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1972. 8p. (In Russian). INIS.

Using data on the cross section of interaction of particles with protons and deuterons, the cross sections of interaction of particles with 25- to 60-GeV neutrons were found. The results agreed with the relation $6(pp) - 6(pn) = 6(K^+p) - 6(K^+n)$ predicted by the quark model. (tr-auth)

22397 (INIS-MF-1168-2, pp vp, 15p) MESON EXCHANGE CURRENTS IN THE TWO-NUCLEON SYSTEM. Riska, D. O. (State Univ. of New York, Stony Brook). 1973.

From Finnish summer school in nuclear physics; Liperi, Finland (11 Jun 1973).

Some examples of reactions in the two-nucleon system are considered to illustrate meson exchange currents. The e + d and p + p interactions are discussed. (JF)

22398 (ITF-74-46E) SOME CONSEQUENCES OF THE EQUALITY OF PP- AND NP SCATTERING TOTAL CROSS-SECTIONS. Lend'el, A. I.; Lend'el, V. I. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1974. 12p. Dep. NTIS (US Sales Only) $4.00.

The assumption that the total cross-sections of pp- and np-scattering in energy region E > 10 GeV are equal, what is confirmed in Serpukhov accelerator experiment in 10–60 GeV region, allows to use the dispersion relations for the amplitude of nucleon–nucleon scattering without subtraction. In the present work the comparison of such unsubtracted dispersion relations for the NN-scattering with the experiment is carried out. The obtained results agree quite well with the available experimental data. (auth)

22399 (KHFTI-73-9, pp 3-5) MODERN THEORY STATE OF INELASTIC PARTICLE INTERACTION WITH NUCLEI AT VERY HIGH ENERGIES. Barashenkov, V. S.; Eliseev, S. M. (Joint Inst. for Nuclear Research, Dubna, USSR). 1973. (In Russian).

A test to extend the cascade-evaporation model to a description of π-N and N-N interactions within the nucleus in the energy range from 10 to 10^3 GeV is proposed. Experimental and calculated data are reported. The divergence principles are analyzed. (tr-auth)

22400 (KHFTI-73-9, pp 6-8) POTENTIAL ENERGY AND EFFECTIVE Λ-HYPERON MASS IN A NUCLEAR MATERIAL. Filimonov, V. A. (Tomsk Polytechnic Inst., USSR). 1973. (In Russian).

An analysis was made of the binding energy of Λ particles in the B_Λ hypernucleus. Analysis indicated the existence of a strong dependence of the Λ nuclear potential on the momentum Λ. The ratio of the effective mass of Λ to the usual mass characterizing this dependence showed approximately the same as for nucleons in nuclear substances. (tr-auth)

22401 (KHFTI-73-9, pp 84-88) DEEP ATTRACTION POTENTIAL WITH FORBIDDEN STATES FOR N–N INTERACTION AND ENERGY DEPENDENCE OF SCATTERING PHASES. Obukhovskii, I. T.; Korennoi, V. P.; Kukulin, V. I.; Neudachin, V. G. (Inst. of Nuclear Physics, Moscow). 1973. (In Russian).

For description of N-N interactions a simple attractive local potential model in which there is an excess of the low lying bound states was proposed. The phase displacements calculated with this model were compared with experimental data and calculations by other models. In the framework of the proposed model a calculation was made of the differential cross section for deuteron breakdown by electrons close to the breakdown threshold. (tr-auth)

22402 (LBL-3022) ANTIBARYON PRODUCTION AND HIGH ENERGY OSCILLATIONS. Koplik, J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Apr 1974. Contract W-7405-eng-48. 50p. Dep. NTIS $5.50.

Thesis.

Multiperipheral models are used to investigate the proposal that the experimentally observed production of antibaryons can account for most or all of the rise in the pp total cross section at ISR energies. The models support the proposal, and furthermore predict that this rise is the first part of a long-wavelength damped oscillation as a function of energy. It is found that a variety of models accommodate the antibaryon effect, it is shown that these all lead to total cross sections consistent with present data and displaying an oscillation at higher energies. An attempt is made to understand the antibaryon cross section itself within the special case of the ABFST model, and it is found that the observed energy threshold emerges naturally, but that the predicted magnitude is somewhat small. The oscillations are simply parametrized in terms of complex Regge poles, and one of the models studied suggests that the leading complex pole be identified with the P'. (auth)

22403 MESON THEORETIC NUCLEON–NUCLEON POTENTIAL. Nutt, W. T. Seattle; University of Washington (1974). 200p. University Microfilms Order No. 74-15,521.

Thesis (Ph.D.).

A meson theoretic model of the nucleon–nucleon potential is presented with emphasis placed on the two-pion exchange contribution. The model for pi-nucleon scattering consistent with the approximate two-pion contribution is examined in the s- and t-channel. Comparisons with both experimental results and soft-pion theorems are presented. The use of the one-nucleon Green's function of Brown, Puff, and Wilets, which contains a conjugate pair of complex "ghost states," causes the Adler–Weinberg soft-pion condition on pi-nucleon scattering to be nearly satisfied. Because of this and the improvement of the pi-nucleon s-channel near threshold, it is unnecessary to introduce nucleon-antinucleon pair suppression in this model. Following the prescription of Partovi and Lomon, the potential is obtained via a Blankenbecler–Sugar reduction of a covariant equation of the Bethe–Salpeter form for the invariant amplitude to a Lippmann–Schwinger equation. The explicit energy dependence of the potential is retained along with non-locality (in the first order) and compared with an energy-independent approximation. Partovi and Lomon's energy-independent approximation is compared with these approximations. Off-shell scattering matrices are calculated for both of the presented approximations and compared to the Reid soft-core phenomenological potential. The comparison is made by adjusting the short range ($r < 0.7$ fm) of the wave function to reproduce the on-shell scattering data. (Diss. Abstr. Int., B)

22404 CLASSICAL FIELD THEORIES ON COMPLEX MANIFOLDS. Peterson, M. A. Palo Alto, CA; Stanford Univ. (1973). 117p. University Microfilms Order No. 74-13,711.

Thesis (Ph. D.).

Complex geometry is considered as a possible model for hadronic interactions. The method is to consider analogies of general relativity theory, electromagnetic theory, and Dirac theory in an Hermitian metric complex analytic manifold. The analogue of the Palatini variational characterization of the Einstein equations is found to require the metric to be Kaehlerian and the connection to be Kaehlerian up to a vector part which is arbitrary. A variational equation of motion (*) for the Kaehler metric, uniquely determined by gauge considerations, is found. Spherically symmetric solutions are obtained. An analogue of the Dirac differential operator is defined which is like the Cauchy–Riemann operator, but in which the exterior algebra is replaced by the Clifford algebra of the metric. This operator is shown to determine a cohomology theory which is closely related to the Dolbeault cohomology but depends on the metric. The analogues of electromagnetic theory and Dirac theory are then found by enforcing covariance with respect to different actions of the unitary group on the Clifford algebra. A physical interpretation is attempted in which the complex analytic manifold is the Cartesian product of space-time with itself, and all geometric objects depend on only the first factor (the real part of the complex variables). In this case there are spherically symmetric solutions to (*) which give rise to volume elements falling off exponentially with distance, like observed hadronic potentials. This exponential falloff is unchanged by complex analytic coordinate transformations which do not mix real and imaginary parts. This potential or volume element is a pseudoscalar under inversion. It suggests that mesons might be volume elements within which the geometry of interaction is complex rather than Minkowskian. (Diss. Abstr. Int., B)

22405 GROWTH OF TOTAL CROSS SECTIONS AND ELASTIC SCATTERING. Solov'ev, L. D. (Inst. of High-Energy Physics, Serpukhov, USSR). JETP Lett. (USSR) (Engl. Transl.); 19: No. 3, 116-118(5 Feb 1974).

Translated from Zh. Eksp. Teor. Fiz.; Pis'ma Red.; 19: No. 3, 185-188(5 Feb 1974).

A simple expression is proposed for the amplitude of elastic proton–proton scattering; this expression corresponds to the Froissart growth of the total cross section and describes satisfactorily all the differential cross section data obtained with the CERN storage rings. (auth)

22406 NUCLEON–NUCLEON INTERACTION AND THE INTERACTION OF NUCLEONS WITH ISOBARS. Brown, G. E. (NORDITA, Copenhagen). Contract AT(11-1)-3001. pp 3-9 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973). See CONF-730642-.

The origin of the nucleon-nucleon interaction from the exchange of the π- and ω-mesons and from two-pion exchange, is discussed. The two-pion exchange term is described in a dispersion theoretical formalism, and it is shown how the π-π scattering phase shift $\delta_{\pi\pi}^{I=0}$ governs the strength of the σ-degrees of freedom. Going over to dynamical models, the interaction of nucleons with the $N\frac{3}{3}$-isobar is discussed. A model for the two-pion exchange involves the virtual isobar as intermediate state. The presence of virtual isobars is seen, perhaps most clearly, in the process $n + p \rightarrow d + \gamma$. The isobar also enters into various exchange current corrections to magnetic moments and β-decay. Using any one of several simple models for the isobar, a consistent picture of the various phenomena in the two- and three-nucleon systems can be achieved. (auth)

22407 NEW FIELD THEORETICAL APPROACH TO THE NUCLEON–NUCLEON INTERACTION. Turchetti, G. (CEN de Saclay, Gif-sur-Yvette, France). pp 41-43 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973). See CONF-730642-.

A genuine field theoretical scheme, based on a variational approximation to the Green function, is proposed for the nucleon-nucleon interaction. (auth)

22408 SEARCH FOR A PARITY-VIOLATING CONTRIBUTION TO NUCLEON–NUCLEON SCATTERING. Nagle, D. E.

(Los Alamos Scientific Lab., NM); Hwang, C. F.; Jarmie, N.; Lovoi, P. A.; McKibben, J. L.; Mischke, R. E.; Ohlsen, G. G.; Potter, J. M.; Stevens, R. R. Jr.; Debrunner, P. pp 70-72 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973). See CONF-730642-.

One manifestation of the weak interaction between nucleons would be a parity-violating effect in nucleon-nucleon scattering. It is expected that such effects exist, at least at the level of 10^{-7} of the normal cross section, in low-energy pp and pd scattering. An experiment has been undertaken at 15 MeV to detect a small dependence of the pp scattering cross section on the longitudinal polarization of the beam. Current efforts are concentrating on reducing systematic effects which at present restrict the sensitivity to the level of 2×10^{-4}. (auth)

22409 KAON-IN-FLIGHT EXCITATION OF STRANGENESS ANALOG STATES. Deloff, A. (Inst. for Nuclear Research, Warsaw); Piekarz, J. pp 73-76 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973). See CONF-730642-.

Strangeness exchange reactions induced by kaons in flight on nuclei have been investigated. The calculated cross sections for excitation of strangeness analog states turned out to be of the order of a few millibarns for light elements. (auth)

22410 DEUTERIUM AS A NEUTRON TARGET. Harrington, D. R. (Rutgers—The State Univ., New Brunswick, NJ). pp 118-122 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973). See CONF-730642-.

The use of deuterium as a neutron target is discussed. Corrections to the impulse approximation due to Fermi motion, final state interactions, and double scattering are reviewed. Possible tests of the extraction procedures are also considered. (auth)

22411 STRONG INTERACTION EFFECTS IN HADRONIC ATOMS. Koch, H. (Univ., Karlsruhe, Ger.). pp 225-238 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973). See CONF-730642-.

Recent results on shifts and widths of energy levels in pionic, kaonic, antiprotonic, and Σ^--hyperonic atoms are discussed. A large amount of the data existing today on strong interaction effects in kaonic, antiprotonic, and Σ^--hyperonic atoms is presented in the tables and compared with calculations. This comparison tries to give an impression of how much of the data is already understood and can be used to give information on physical properties of the systems involved. Besides the discussion of the strong interaction effects, a summary of other recent results on hadronic atoms is given, e.g., the π^- and K^- masses, the polarizability of the kaon, and the magnetic moments of the antiproton and the Σ^- hyperon. (auth)

22412 OPTICAL POTENTIALS FOR HADRONIC ATOMS. Wycech, S. (Inst. for Nuclear Research, Warsaw). pp 239-246 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973). See CONF-730642-.

Strong shifts of the electromagnetic levels in the hadronic (mainly kaonic) atoms and a description of these in terms of the optical potentials are discussed. Some problems and difficulties in the determination of the potentials from the elementary interactions are reviewed. Several theoretical attempts to deal with this question and various approximations are presented. At the moment there is no entirely satisfactory description of the data, partly because of our poor knowledge of the elementary interactions below the hadron nucleon mass threshold. The conclusion is drawn that the atomic experiments are a good way to test the theoretical models, but to learn about the structure of the nuclear surface the processes of strong decay and decay products must be studied as well. (auth)

22413 NONLOCAL SEPARABLE POTENTIAL AND p—p SCATTERING. Ali, S.; Rahman, M.; Husain, D. (International Centre for Theoretical Physics, Trieste, Italy). Phys. Rev., C; 9: No. 4, 1657-1658(Apr 1974).

The S-wave p-p scattering phase shifts for the energy range of 0—400 MeV (lab) were calculated using a Mongan-type interaction. Coulomb effects were included exactly. (auth)

22414 UNIFIED TREATMENT OF THE pd → dp AND pp → π^+d PROCESSES IN A MODEL OF N AND N* EXCHANGES. Sharma, J. S.; Mitra, A. N. (Univ. of Delhi). Phys. Rev., D; 9: No. 9, 2547-2557(1 May 1974).

A unified account of two related processes, pd → dp and pp → π^+d, is presented in a scheme of higher baryon couplings developed by this group. The work which represents a considerably improved version of an earlier model for the study of the pd → dp process at moderately high energies (1.0—1.5 GeV) is now extended to include (i) lower energies (down to 300 MeV) for pd → dp, and (ii) the related process pp → π^+d, within a common set of assumptions for the N and N* exchange vertices. The fits to the data for both the processes come out rather well over their respective energy ranges, which are appreciable. (auth)

22415 PRODUCTION OF MASSIVE LEPTON PAIRS IN HADRONIC COLLISIONS. Thacker, H. B. (State Univ. of New York, Stony Brook). Phys. Rev., D; 9: No. 9, 2567-2584(1 May 1974).

The production of lepton pairs of large invariant mass in high-energy hadronic collisions is studied. A general method for treating the typical phase-space integrations that arise is derived and employed in subsequent model calculations. The general properties of annihilation models are discussed in an invariant context, and the various distributions are studied in a pion-annihilation model. The SU(3) properties of the quark-annihilation model are investigated and the cross section is related to deep-inelastic neutrino structure functions. A model is studied in which the lepton pair is emitted by a bremsstrahlung process, and a cancellation among the several graphs is seen to reduce the incident energy dependence by one power of s. (auth)

22416 CORRELATIONS IN PP-COLLISIONS AND TWO-COMPONENT MODELS. Chaudhary, B. S.; Gupta, V. (Tata Inst. of Fundamental Research, Bombay). Pramana; 2: No. 5, 243-251(May 1974).

Some general consequences of charge conservation inclusive sum rules for the correlation integrals f_k and f_{g_k} are given. It is also pointed out that the energy dependence of f_k or f_{g_k} is $\langle n \rangle^k$ for $k \leq 7$ for pp collisions and that the data suggest all the f_k and f_{g_k}'s are nonzero. Further, two-component models for the charge multiplicity distribution consistent with charge conservation are considered and compared with the data for pp collisions. (1 figure, 2 tables) (auth)

22417 DIFFRACTIVE AND NON DIFFRACTIVE COMPONENTS OF THE MULTIPLICITY DISTRIBUTION IN PP COLLISIONS. Narayan, D. S. (Tata Inst. of Fundamental Research, Bombay). Pramana; 2: No. 5, 252-258(May 1974).

Topological cross sections for diffractive and nondiffractive components in pp collisions are deduced on the basis of a dynamical model proposed earlier to explain the multiplicity distribution of charged particles. The model has an important prediction for the angular and momentum distributions of charged particles in diffractive events. (4 figures, 1 table) (auth)

Particle Invariance Principles and Symmetries

Refer also to abstract 22648.

General

Refer also to abstract 23008.

22418 (JINR-E2-8009) QUANTIZATION OF CHIRAL THEORIES. Pervushin, V. N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 20p. Dep. NTIS (US Sales Only) $4.00.

The perturbation theory in which all possible reductions of matrix elements, i.e., contractions of lines on the Feynman diagrams are absent is formulated in terms of the Cartan forms. (auth)

22419 (JINR-P2-7866) DIMENSIONAL PROPERTIES OF THE HAMILTONIAN DENSITY. Dao Vong Duc. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 12p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

The behavior of the components of the energy-momentum tensor under scale transformation is considered. The dimensional

property of the Hamiltonian density is discussed. It is proved that if the part of the Hamiltonian density, responsible for the scale invariance violation, has a dimensionality −3 then the dimensionality of any operator F(x) (if it is being determined for this operator) with $\langle \pi(\vec{0}) | F | \pi(\vec{0}) \rangle \neq 0$ or $\langle N(\vec{0}) | F | N(\vec{0}) \rangle \neq 0$, is also equal to −3. (auth)

22420 SCALING BEHAVIOR IN SOLVABLE QUANTUM SYSTEMS. Oliver, J. N. Boston; Boston University Graduate School (1973). 111p. University Microfilms Order No. 74-14,222.

Thesis (Ph.D.).

Questions relating to scale invariance are discussed within the framework of solvable quantum models. The systems are treated by the methods of quantum field theory. By examining such systems we can trace the breakdown of scaling in formally scale invariant models in a way which is independent of perturbation theory. A relativistic scale invariant model, the Okubo model, is discussed. This model, solvable in any number of dimensions, is shown to possess an anomalous dimension in Minkowski 2-space. In four dimensional Minkowski space the anomalous dimension is imaginary and therefore cancels out in any bilinear structures such as Green's functions. The Zachariasen model and several non-relativistic solvable models are also discussed. (Diss. Abstr. Int., B)

22421 CONNECTIONS BETWEEN THE SCHROEDINGER GROUP AND THE CONFORMAL GROUP. Niederer, U. (Univ., Zurich). Helv. Phys. Acta; 47: 119-129(1974).

The Schrödinger group is generalized to the maximal set of coordinate transformations which leave invariant the Schroedinger equation up to the mass. These generalized Schroedinger transformations do not form a group but contain the Schroedinger group as a subset. It is shown that the nonrelativistic limit of the conformal group, which is interpreted as the maximal invariance group up to the mass of the massive Klein−Gordon equation, is a subset of the generalized Schroedinger transformations which, when modified by additional transformations, contains the Schroedinger group. (auth)

22422 SYMMETRY VIOLATIONS. Henley, E. M. (Univ. of Washington, Seattle). pp 22-32 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973). See CONF-730642-.

The present experimental and theoretical status of some inexact symmetries is reviewed. Starting with hadronic interactions, which break SU(3), the presentation passes through the electromagnetic interactions which break isospin and possibly time reversal invariance. The discussion ends with the weak interactions and related symmetries, namely those associated with the weak currents and with parity, primarily in hadronic systems. Experiments that can shed further light on the symmetry-breaking effects are suggested. (auth)

Applications (Electromagnetic and Weak)

Refer also to abstract 22354.

22423 CHIRAL-SYMMETRY BREAKING AND THE $C_K C_\pi$ RATIO. Kimel, I.; Robilotta, M. R. (Univ., Sao Paulo, Brazil). Lett. Nuovo Cim.; 10: No. 15, 666-670(10 Aug 1974).

A symmetry-breaking model based on a Hamiltonian where the symmetry is broken according to the representations $(3,\bar{3}) \oplus (\bar{3},3) \oplus (8,8)$ is presented, which leads to π and K fields that are mixtures of $(3,\bar{3}) (+) (\bar{3},3)$ plus (8,8) field. The $\eta-\eta'$ mixing angle is related to the symmetry-breaking parameters based on the ansatz that the η is also such a mixture. The model also yields an expression for C_K/C_π in terms of the π, K, and η masses only. (LBS)

Applications (Strong)

Refer also to abstracts 22360 and 22362.

22424 PRESENT STATUS OF SU(6) SYMMETRY AND OF THE EXOTICS PROBLEM. Freund, P. G. O. (Univ. of Chicago). pp 121-133 of Baryon Resonances, 73. West Lafayette, IN; Purdue Univ. (1973).

From conference on baryon resonances; West Lafayette, Indiana, USA (20 Apr 1973). See CONF-730477-.

The quantitative problems of mass formulas and coupling constant relations related to the meaning and breaking of $U(6) \times O(2)_W$ symmetry and the problem of exotic hadrons (mesons, baryons, dibaryons, tribaryons, etc. ...) are treated. It is clearly shown which of the present ideas unambiguously predict the existence of exotics. It is found that exotics are a necessity, unless one is willing to give up duality. (JFP)

22425 SU(3) SYMMETRIC COUPLING OF MESONS TO BARYONS. Meiere, F. T. (Indiana-Purdue Univ., Indianapolis); Fischbach, E. pp 151-155 of Baryon Resonances, 73. West Lafayette, IN; Purdue Univ. (1973).

From conference on baryon resonances; West Lafayette, Indiana, USA (20 Apr 1973). See CONF-730477-.

The values for $g^2/4\pi$ are found to be $\pi NN = 14.6 \pm 0.2$, $K N\Sigma = 0.9 \pm 1.5$, $\pi\Sigma\Lambda = 17.8 \pm 7$, $\pi\Sigma\Sigma = 9.0 \pm 5$, and $K N\Lambda = 4.0 \pm 2.4$. These lead to the conclusion that the conventional KG/ps coupling is in relatively poor agreement with SU(3) while DKP/pv coupling is in excellent agreement with SU(3). (JFP)

22426 SYMMETRIC QUARK MODEL ANALYSIS OF THE MASSES AND DECAY RATES FOR $(70,1^-)$ STATES. Jones, M. (Chicago Univ.); Setti, R. L.; Lasinski, T. pp 455-461 of Baryon Resonances, 73. West Lafayette, IN; Purdue Univ. (1973).

From conference on baryon resonances; West Lafayette, Indiana, USA (20 Apr 1973). See CONF-730477-.

In an attempt to find some guidance in the search for baryon resonances, the $(70,1^-)$ representation of $SU(6) \times O(3)$ was reanalyzed by applying the symmetric quark model as formulated previously and making use of the most recent experimental information. The baryon resonances, masses, total widths, elasticity, and dominant decay mode were discussed. (JFP)

22427 SYMMETRIES RELATED TO THE QUARK MODEL. Ne'eman, Y. (Tel Aviv Univ., Israel). pp 10-21 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973). See CONF-730642-.

A discussion is given of the conceptual foundation relating together three lines of work which have sprung out of SU(3) since 1964: current algebra, the supermultiplet (SU(6) etc.) symmetries based upon a non-relativistic quark model, and the algebra of complex-J vertex-strengths. The latter embodies the results derived heuristically from an "independent quark model" in high energy processes. Several unitary transformations enable us to use the weak and electromagnetic currents as a canonical basis, though one could now also invert the sequence and start from strong-interaction quarks defined by high energy asymptotics. (auth)

Scattering Theory

Refer also to abstracts 22911 and 23013.

22428 (IC-73-162) GENERAL FRAMEWORK FOR NUCLEAR RESONANCE THEORIES IN TERMS OF THE BLOCH FORMALISM. Vitturi, A.; Zardi, F. (International Centre for Theoretical Physics, Trieste (Italy)). Nov 1973. 28p. INIS.

The method of the boundary-condition operator introduced by Bloch is exploited in order to set up in a compact form the "generalized collision matrices" formalism, with particular reference to the S- and K-matrices. It is shown that a suitably defined "natural Green's function" is associated with each generalized collision matrix M; explicit representations of this operator lead to the generalization of the Kapur−Peierls and the Weinberg states theories. These representations enable us to consider in a simple way the analytic continuation of M and to deduce its poles and residues; for the S- and K-matrices the results coincide with the well-known ones, obtained by the matching method. One is also naturally led to consider the energy-power expansion of M; in this connection the Pade and Hadamard methods for the analytic continuation are exploited. The generalized Heitler relation holding for any two collisions matrices is finally obtained. (INIS)

22429 (ITF-74-19P) QUANTUM-MECHANICAL SCATTERING THEORY FOR MANY-PARTICLE SYSTEMS. Sigal, I. M. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1974. 22p. (In Russian). Dep. NTIS (US Sales Only) $4.25.

A rigorous foundation of a quantum scattering theory is given for the systems of arbitrary but not fixed number of particles. A theorem on constructing a resolvent of the Schroedinger operator of many-particle system is obtained, from which there follows the existence and completeness of the wave operators for all kinds of channels. (auth)

22430 (ITF-74-52E) DUAL PROPERTIES OF DAMA. Jenkovszky, L. L. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1974. 20p. Dep. NTIS (US Sales Only) $4.00.

Dual properties of a class of Mandelstam analytic amplitudes

(DAMA) are studied: 1) a lower bound on Regge trajectories is obtained by utilizing duality; 2) the content of duality in the model with broad resonances is discussed. (auth)

22431 (KHFTI-73-9, pp 40-42) THEORY OF HIGH-ENERGY APPROXIMATION IN POTENTIAL SCATTERING PROBLEM. Babikov, V. V.; Mir-Kasimov, R. M.; Khankhasev, M. Kh. (Joint Inst. for Nuclear Research, Dubna, USSR). 1973. (In Russian).

A new approach to the study of the amplitudes of high energy scattering by use of a generalization of the known method of phase functions with cases of partial amplitude to total scattering amplitudes was developed. Within the framework of this approach a high energy approximation was made for the total scattering amplitudes. (tr-auth)

22432 PHENOMENOLOGICAL TREATMENT OF DUAL LOOP CONTRIBUTIONS TO INCLUSIVE REACTIONS. Ebert, D. (Humboldt Univ., Berlin). Ann. Phys. (Leipzig); 29: No. 2, 137-148(Jul 1973).

A phenomenological B_8 type amplitude is constructed which contains Regge singularities of twisted loop graphs such as ordinary trajectories, Regge cuts and Pomeron trajectories. With this amplitude possible implications of the different one and two-loop graphs for single particle distributions are derived for different kinematical regions including the fixed angle limit. The results emphasize the importance of dual loop contributions to single particle distributions. (auth)

22433 ABSORPTION IN MULTIPRODUCTION AMPLITUDES: AN EIKONAL PRESCRIPTION. Marchesini, G. (Univ., Parma, Italy). Lett. Nuovo Cim.; 10: No. 15, 671-675(10 Aug 1974).

A successful attempt was previously made to implement unitarity in multiproduction amplitudes by introducing absorptive corrections among produced particles. An attempt is made to justify the absorptive prescription on the basis of a field-theoretic model in the eikonal approximation. (LBS)

22434 NEW IMPACT-PARAMETER EXPANSION OF THE SCATTERING AMPLITUDE. Mikami, H. (Gumma Prefectural Coll. of Radiology, Maebashi, Japan). Lett. Nuovo Cim.; 10: No. 15, 661-665(10 Aug 1974).

A new impact-parameter expansion is formulated in terms of the spherical Bessel function and some properties of the new impact-parameter amplitude are discussed. (LBS)

22435 OPTICAL THEOREMS FOR GENERAL COLLISIONS. Cahill, K. E. (CEN de Saclay, Gif-sur-Yvette, France). Lett. Nuovo Cim.; 10: No. 13, 577-580(27 Jul 1974).

Exact discontinuity formulas are described which apply to collisions with arbitrary numbers of particles in the initial and final states. The discontinuities are expressed exclusively in terms of physical scattering amplitudes. (LBS)

22436 TEMPORALLY INHOMOGENEOUS SCATTERING THEORY. Monlezun, C. J. (Pennsylvania State Univ., University Park). J. Math. Anal. Appl.; 47: No. 1, 133-152(Jul 1974).

A theory of scattering for the time dependent evolution equations $du/dt = iH_j(t)u$, $j = 0,1$ is developed. The wave operators are defined in terms of the evolution operators $U_j(t,s)$, which govern (*). The scattering operator remains unitary. Sufficient conditions for existence and completeness of the wave operators are obtained; these are the main results. General properties, such as the chain rule and various intertwining relations, are also established. Applications include potential scattering ($H_0(t) = -\Delta, \Delta$ denoting the Laplacian, and $H_1(t) = -\Delta + q(t,.)$) and scattering for second-order differential operators with coefficients constant in the spatial variable ($H_j(t) = \Sigma_{m,k=1}^{n} a_{mk}^{(j)}(t)(\partial^2/\partial x_m \partial x_k) + b_j(t)$ for $j = 0,1$). (auth)

22437 COMPLETELY UNITARY APPROXIMATIONS IN THREE-PARTICLE SCATTERING. Sharma, D. K. Cleveland; Case Western Reserve University (1974). 159p. University Microfilms Order No. 74-16,525.

Thesis (Ph.D.).

Completely unitary approximations based on a K-matrix formalism are used to investigate the role of unitarity along with the correct two-particle input as a determinative feature of three-particle scattering. The elastic differential cross sections of neutron–deuteron scattering are calculated at 14.1, 50, and 100 MeV incident neutron energies within the framework of the Amado model for the two-particle input and using two successive approximations for the three-body K-matrix. The first of these approximations consists of retaining the zero-order and second of retaining the zero-order and first-order terms in the multiple scattering series for the three-body K-matrix. The results are compared with calculations using the so-called Quasi-Unitary model and exact calculations with the same two-particle input. The results are found to be moderately successful in predicting the three-particle amplitudes. This indicates that the three-particle amplitudes are relatively insensitive to large errors in the three-particle K-matrix used in our formalism. The convergence of the multiple scattering series of the three-particle K-matrix is partially investigated by comparing the first and second terms in the series. The results imply that the series is slowly convergent or even divergent for lower partial waves and that more sophisticated approximation schemes than those of simple truncations of multiple scattering series are needed in order to obtain quantitatively accurate results. This constitutes the first calculations of three-particle amplitudes using a completely unitary K-matrix formalism in a multi-channel scattering problem. (Diss. Abstr. Int., B)

22438 UNITARITY RELATIONS AND THE CHARACTERISTIC OPERATOR FUNCTION FOR A THREE-BODY SCATTERING PROCESS. Johnson, L. E. Iowa City, IA; University of Iowa (1973). 70p. University Microfilms Order No. 74-16,645.

Thesis (Ph.D.).

A completely solvable quantum-mechanical three-particle system that includes breakup is discussed. The partial-wave amplitudes obtained are written in an abstract form to remove their dependence on potential theory, and unitarity is then used to specify genuine production amplitudes. The characteristic operator function is calculated for the resulting set of partial-wave amplitudes, as a physical illustration of the harmonic analysis approach to three-body unitarity. (Diss. Abstr. Int., B)

22439 ORTHOGONALITY CONDITION IN MANY-BODY SCATTERING THEORY. Csanak, G. (Southern California Univ., Los Angeles). J. Phys., B (London); 7: No. 7, L203-L205(11 May 1974).

It is shown that the orthogonality condition referring to total scattering states with identical boundary conditions is satisfied in the random phase approximation. This orthogonality condition is also discussed for elastic scattering. (auth)

22440 VARIATIONAL SOLUTION OF A MODEL BREAKUP PROCESS. Bottcher, C.; Bryce, W. M.; Mandl, F. (Manchester Univ., Eng.). J. Phys., B (London); 7: No. 7, 769-781(11 May 1974).

A two-dimensional model of three-body breakup with short range forces is described. The variational principle of Bryce and Mandl (J. Phys. B. Atom. Molec. Phys.; 5: 912-20 (1972)) is applied to this model and reduced to a set of linear equations. Nonlinear parameters are determined by minimizing the deviation from unitarity. As the number of parameters in the trial wave function increases, the scattering amplitudes are shown to converge. For a complete solution of the problem the variational calculation is supplemented by the Born approximation. It is concluded that more complicated variational calculations are feasible. (auth)

22441 VARIATIONAL PRINCIPLE FOR SCATTERING FROM AN ASYMMETRIC NON-LOCAL POTENTIAL. Singh, S. R.; Stauffer, A. D. (York Univ., Toronto). J. Phys., B (London); 7: No. 7, 782-787(11 May 1974).

A variational method, analogous to that of the Kohn method in potential scattering, is derived which solves integro-differential equations with asymmetric kernels. The method is applied to S-wave elastic scattering of electrons from hydrogen atoms in the polarized-orbital approximation. (auth)

22442 GENERALIZED O(2,1) EXPANSION IN THE SPACE-SPACE REGION. (Tata Inst. of Fundamental Research, Bombay). Ann. Phys. (N. Y.); 83: No. 1, 186-202(Mar 1974).

Following the approach of Jones, Low and Young, a generalized O(2,1) expansion is developed for amplitudes that have a power bounded growth asymptotically. The expansion, set up in an O(1,1) basis, holds in a new kinematical region, where all the incoming and outgoing clusters have space-like O(2,1) momenta. (auth)

22443 UNITARITY AND CAUSALITY IN THE GENERALIZED PAULI–VILLARS REGULARIZATION. Slavnov, D. A. (Moscow State Univ.). Teor. Mat. Fiz.; 19: No. 3, 291-299 (Jun 1974). (In Russian).

In the perturbation theory framework the unitarity and the micro-causality of the S-matrix regularized by means of the generalized Pauli–Villars regularization is proved. (auth)

22444 ONE-TIME EQUATION FOR THE SCATTERING OF PARTICLE ON BOUND STATE IN QUANTUM FIELD THEORY. Arkhipov, A. A.; Savrin, V. I. (Inst. of High Energy Physics, Serpukhov, USSR). Teor. Mat. Fiz.; 19: No. 3, 310-324(Jun 1974). (In Russian).

It is demonstrated how the one-time formulation of the relativistic many-body problem leads to the quasipotential equation for the scattering of two particles, one of which represents the bound state of two other particles. The effective potential of this interaction is expressed through the quasipotentials of pair interaction and also through the quasipotential which cannot be reduced to pair quasipotentials. (auth)

PHYSICS (LOW-TEMPERATURE)

Superfluidity

Refer also to abstract 21547.

22445 (AD-775899/8) THIRD SOUND VELOCITY AND ATTENUATION BELOW 1.2 DEGREES KELVIN. Scholtz, J. H. (California Univ., Los Angeles (USA). Dept. of Physics). Dec 1973. Contract N00014-69-A-0200-4014. 153p. NTIS $5.00.

The velocity of third sound on glass and CaF_2 substrates and at a variety of film thicknesses has been measured using a He_3 cryostat from temperatures of 1.2 K down to 0.5 K. Then with a dilution refrigerator the results on glass were extended to 0.1 K. The third sound was generated and detected thermally in the usual manner, and the velocity was determined by measuring the time of flight of a pulse. Film thicknesses are found by measuring the chemical potential of the film at 1.5 K. Third sound has now been observed in films as thin as 2.1 atomic layers, and hence indicates the existence of superfluidity in two dimensional systems. The attenuation of third sound on glass has been measured as a function of frequency at temperatures from 1.2 K down to 0.7 K and over a variety of film thicknesses. (GRA)

22446 MELTING PRESSURE OF HELIUM-3 AT VERY LOW TEMPERATURES. Goldstein, L. (Los Alamos Scientific Lab., NM). J. Low Temp. Phys.; 15: No. 5/6, 583-599(Jun 1974).

The melting pressure of ^{3}He at very low temperatures was shown earlier to be determined overwhelmingly by the solid phase. Using an extended solid ^{3}He model based on isotropic effective first-neighbor-pair antiferromagnetic and second-neighbor-pair ferromagnetic exchange interactions, the melting process is reinvestigated here. One of its motivating aspects may be said to be tied to its possible use, suggested by us earlier, for the establishment of a thermodynamic temperature scale at very low temperatures. As a consequence of the assumed multineighbor interactions, spin ordering is accelerated and, at the same temperature, the extended-model solid entropy falls below that of the simpler nearest-neighbor-pair interaction model. Equivalently, the spin-ordering critical transition temperature is raised over that associated with the simpler interaction scheme. The overall result is a decrease in the melting pressure variations at very low temperatures below those arising from the simple solid model. In the absence of a reliable experimental temperature scale at very low temperatures, only a qualified and cursory comparison is justified with recent experimentally estimated melting pressures. Discrepancies arise between theory and preliminary data on the temperature derivatives of the melting pressure or the entropy of the solid at melting. They might be due in part to the tentative experimental temperatures, which appear shifted toward too low temperatures when compared with the theoretical temperature scale implicit in the treatment of the generalized solid model. However, from the viewpoint which accepts the rather preliminary, scarce, very low temperature melting pressure data at face value, failure of the extended exchange model of solid ^{3}He at those temperatures must be kept in mind. (auth)

22447 HYDRODYNAMIC THEORY OF FOURTH SOUND IN CLAMPED CONDITIONS. Achiam, Y.; Bergman, D. J. (Tel Aviv Univ., Israel). J. Low Temp. Phys.; 15: No. 5/6, 559-576(Jun 1974).

The hydrodynamic theory of fourth sound is developed in detail for the cases of a flat capillary and a porous superleak filled with superfluid helium whose normal fluid motion is completely clamped. The attenuation is calculated including rigorously all the thermal conduction effects in both the helium and the capillary walls. Also included in the case of the superleak are the Rayleigh scattering and the thermal effects of the resonator walls. Comparison of the superleak results with existing experiments leads to the conclusion that Q factors of fourth-sound resonators could be increased considerably. (auth)

22448 PRESSURE DEPENDENCE OF THE ROTON SPECTRUM IN LIQUID HELIUM. Bartley, D. L. (Univ. of Michigan, Ann Arbor); Robinson, J. E.; Woo, C. W. J. Low Temp. Phys.; 15: No. 5/6, 473-479(Jun 1974).

Consistency checks on neutron scattering data on liquid helium under pressure are suggested. The theoretically calculated static structure function S(k|P) leads to pressure dependence of the roton gap, momentum, and curvature in general agreement with experiment. (auth)

22449 SECOND SOUND IN DILUTE SOLUTIONS OF ^{3}He IN ^{4}He NEAR ABSOLUTE ZERO. Lawless, P. A. Durham, NC; Duke University (1974). 167p. University Microfilms Order No. 74-13,484.

Thesis (Ph.D.).

Second sound, a propagation of thermal waves, has been used to study the effective mass of ^{3}He atoms in solution with ^{4}He. Dilute solutions were measured over the temperature range of 14 mK to 600 mK at pressures of 0.05, 5.0, 10.0, and 20.0 atm. The concentrations ranged from 0.35% ^{3}He in ^{4}He to 9.43%. The second sound was generated with porous membrane transducers, and the velocities were determined by a time of flight technique. The quality of the data permits a reliable extrapolation of the velocity to absolute zero. Analysis of the results to obtain the effective masses uses sophisticated programming techniques, and as much experimental data as possible is brought into the analysis. Recent theoretical and experimental investigations into the temperature and concentration dependences of the effective mass are examined and, in general, confirmed. The results at absolute zero are anomalous and no good explanation of them has yet been found. (Diss. Abstr. Int., B)

22450 STABILIZATION OF NITROGEN ATOMS IN SUPERFLUID HELIUM. Gordon, E. B.; Mezhov-Deglin, L. P.; Pugachev, O. F. (Inst. of Solid State Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 19: No. 2, 63-65(20 Jan 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 19: No. 2, 103-106(20 Jan 1973).

It is shown that the stationary concentration of nitrogen atoms that are stabilized in superfluid helium exceeds 1.6%. The peculiarities of the recombination radiation have made it possible to estimate the recombination activation energy at 0.1 kcal/mole and to advance the hypothesis that solid nitrogen granules experience thermal explosion on going through the λ point. (auth)

22451 DIRECT EVIDENCE FOR INTERACTIONS BETWEEN ELEMENTARY EXCITATIONS IN SUPERFLUID ^{4}He BY RAMAN SCATTERING. Ohbayashi, K.; Ikushima, A. (Tokyo Univ.). J. Phys., C (London); 7: No. 11, L206-L209(7 Jun 1974).

In the Raman spectrum of superfluid ^{4}He under saturated vapor pressure at 1.51K, fine structures have been observed at energy shifts closely corresponding to twice the energies of the extremal points of the phonon-roton dispersion curve. From the observed cusps, twice the energies of the maximum and plateau regions of the dispersion curve have been determined to be $2\Delta_1 = 27.5 \pm 0.5$ K and $2\Delta_2 = 34.8 \pm 0.5$ K respectively. The two-roton bound state has been resolved as a pronounced single peak, and twice the roton energy and the attractive binding energy of the two-roton state have been determined to be $2\Delta_0 = 17.1 \pm 0.5$ K and $E_B = 0.5 \pm 0.3$ K respectively. The observed fine structures clearly show the existence of the interactions between two elementary excitations having opposite and equal wavevectors. (auth)

22452 SOME EXPERIMENTAL MEASUREMENTS ON LIQUID ^{3}He-^{4}He SOLUTIONS. Brewer, D. F. Acta Univ. Wratislaviensis; No. 141, 1-17 + 12 figs. (1970).

A brief review is given of some of the main experimental results in liquid ^{3}He-^{4}He, without going into detail of the theory or attempting to cover completely all the measurements that have been made. (MHR)

22453 MICROSCOPIC THEORY OF DILUTE ^{3}He-He II SOLUTIONS. Galasiewicz, Z. M. (Univ. of Wroclaw). Acta Univ. Wratislaviensis; No. 141, 1-26(1970).

The derivation of the hydrodynamic equations for dilute solutions of ^{3}He in He II are presented in the schema proposed by Bogolyubov. (MHR)

22454 PHASE TRANSFORMATION IN LIQUID ^{3}He AT VERY LOW TEMPERATURE. Winter, J. M. (CEN de Saclay, Gif-sur-Yvette, France). J. Phys. (Paris), Colloq.; No. 10, 53-57(1973). (In French).

From Centenary congress of the French Physical Society; Vittel, France (28 May 1973).

A review of the new experimental results concerning the properties of liquid ^{3}He at very low temperature and more specially of the new condensed phase of this system, is given. The theoretical models describing these phases are also discussed very briefly. (FR)

22455 PROBLEM OF CRITICAL VELOCITY IN SUPERFLUID HELIUM. Libchaber, A. (Ecole Normale Superieure, Paris). J. Phys. (Paris), Colloq.; No. 10, 83-89(1973). (In French).

From Centenary congress of the French Physical Society; Vittel, France (28 May 1973).

In the last few years, the problem of the critical velocity in superfluid helium has reached a state of agreement between

theory and observation. Thermal critical velocities larger than 1000 cm/s are observed at low temperature and the proposed mechanism is the growth in the flow of thermal ring vortices. The regime of critical velocity obtained from pinned vortices is analyzed. (FR)

22456 APPLICATION OF SUM RULES IN THE THEORY OF SUPERFLUID HELIUM. Szepfalusy, P. (Univ., Budapest). Acta Univ. Wratislaviensis; No. 141, 1-27(1970).

Superfluid helium is considered in two temperature regions, namely at zero temperature and in the critical region close to the second order lambda phase transition point of liquid helium. Information about the parallel susceptibility is obtained by investigating various sum rules for static response functions. After summarizing the sum rules needed in the following, the concern is with liquid helium at zero temperature with a homogeneous condensate. The sum rules are then applied in the critical region. (MHR)

Superconductivity

22457 (AD-776144/8) SUPERCONDUCTIVITY AT THE SURFACE OF LEAD TELLURIDE. Miller, D. L. (Illinois Univ., Urbana (USA). Coordinated Science Lab.). Sep 1973. Contract DAAB07-72-C-0259. 107p. (R-620; UILU-ENG-73-2222). NTIS $4.50.

Ultrathin films of the metals Pb, In, Tl, Sn, and Al were deposited on crystalline PbTe substrates in an attempt to fabricate a system favorable for the observation of an excitonic mechanism of superconductivity. For each of these metals, superconductivity was observed at the PbTe surface. A threshold amount of metal deposited was necessary for superconductivity, and the observed transition temperatures increased as the amount of metal deposited increased beyond the threshold amount. Maximum values of the observed T's at thicknesses less than 100 A were 6.75 K for In, about 5.25 K for Tl, 7.15 K for Pb, 3.4 K for Sn, and 2.6 K for Al. The PbTe substrate surface and the metal overgrowth were characterized by the use of low energy electron diffraction and Auger electron spectroscopy. (GRA)

22458 (AGARD-CP-104, pp 7.1-7.9) SUPERCONDUCTIVITY IN STEADY STATE AND PULSED APPLICATIONS FOR FLIGHT VEHICLES. Lucas, E. J.; Thome, R. J.; Stekly, Z. J. J. (Magnetic Corp. of America, Cambridge, MA). Dec 1972.

From 39th meeting of the AGARD propulsion and energetics panel; Colorado Springs, Colorado, USA (12 Jun 1972).

The ability of the Type-II superconductor to develop high magnetic fields while carrying high current densities naturally leads to applications that are related to power conversion and energy storage. Within this paper, two major applications are presented: MHD magnet systems and pulsed inductive energy storage systems. The use of superconductors in windings for MHD magnets offers definite advantages in size and weight when compared with room temperature or cryogenic coils using normal conductor. This is primarily due to the higher attainable current density in the windings and is graphically illustrated in plots which indicate the relative difference in total and component weights for a given field and field volume. As specific examples, weight and volume estimates are given for the magnet systems required for several power levels and a lightweight magnet system currently under development is described. A comparison of inductive energy storage systems making use of normally resistive cryogenically cooled and superconducting coils is presented, as well as a comparison between inductive and capacitive energy storage elements. The current state-of-the-art in pulsed superconducting energy storage is discussed together with a description of recent results using a model coil. (auth)

22459 (JINR-E4-7746) SOME THEOREMS FOR FREE ENERGY OF MODEL SYSTEMS OF STATISTICAL PHYSICS. Kurbatov, A. M.; Lapushkin, S. S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 17p. Dep. NTIS (US Sales Only) $4.00.

The methods developed by N. N. Bogolyubov (Jr.) for studying model systems of statistical physics with four-fermion interaction are employed for investigation of the system with Hamiltonian of general form. Dynamical operators in it are not concretized, but the fulfillment of some quite general conditions is required. Special cases of this system are the model BCS in the theory of superconductivity, and the models of ferromagnetics of the Heisenberg and Ising type. The theorems for free energy of such model systems, which are the generalization of the well-known theorems, are offered. (auth)

22460 (KFK-EXT-3/73-7) ELECTRONIC SINGLE PARTICLE STATES IN THE FLUXLINE LATTICE IN PURE TYPE-II-SUPERCONDUCTORS. Ries, G. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Experimentelle Kernphysik; Karlsruhe Univ. (TH) (F. R. Germany). Fakultaet fuer Physik). Jan 1974. 44p. (In German). INIS.

4 figs.; 27 refs. With abstract in German and English.

In a pure type-II-superconductor containing a fluxline lattice energy eigenvalues and wave functions of electron single particle states are evaluated solving the Bogolubov equations. Two classes of states are found, bound states which are localized around the fluxline axes and nonlocalized continuum states. The bound states have energies in the range of the BCS gap and are responsible for the gapless behavior of a type-II-superconductor in a magnetic field. For fluxline lattice parameters d approximately larger than 6xi (xi: coherence length) they are identical with the bound states in an isolated fluxline as evaluated by other authors. The continuum states have merely a BCS-like spectrum. Additionally in the periodic pair potential forbidden energy zones occur, the spectrum has a bandstructure. It is shown that the existence of gaps leads to a negative contribution to the free energy of the superconductor which depends upon the fluxline lattice parameter. This can be interpreted as an attractive interaction between fluxlines and explains the discontinuity in the magnetization at H_{c_1} as observed in pure materials. An expression for the equilibrium fluxline lattice parameter d_0 is derived and compared with experiments. (auth)

22461 (KFK-EXT-3/74-5) CHANGES OF THE SURFACE IMPEDANCE OF SUPERCONDUCTING NIOBIUM DUE TO OXYGEN INCLUSIONS. Halbritter, J. (Kernforschungszentrum Karlsruhe (F.R. Germany). Inst. fuer Experimentelle Kernphysik). Mar 1974. 12p. Dep. NTIS (US Sales Only) $4.00.

The temperature and frequency dependence of the penetration depth $\lambda(T,\omega)$ and the surface resistance $R(T,\omega)$ of superconducting Nb show deviations from the BCS theory for homogeneous materials. These deviations are explained by oxygen inclusions in a Nb surface layer, which depress locally superconductivity and hence change the BCS density of states. (auth)

22462 (ZfK-250) MODERN PROBLEMS IN SUPERCONDUCTIVITY. Muenchow, L. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). May 1973. 15p. (In German). Dep. NTIS (US Sales Only) $4.00.

Some problems of modern superconductivity theory are presented. Besides questions of solid body physics like high temperature superconductivity and behavior in magnetic fields, some aspects of application of this theory to nuclear and astrophysics are considered. (auth)

22463 SPLAVY REDKIKH METALLOV S OSOBYMI FIZICHESKIMI SVOISTVAMI. (Alloys of Rare Metals with Special Physical Properties). Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). 216p.

Forty-eight papers are included. Separate abstracts were prepared for thirty-seven. The remaining items were outside the subject scope of NSA. (MHR)

For abstracts of individual papers see: 21584–21586, 21594, 21685–21699, 21819, 22464–22479, and 22536.

22464 SUPERCONDUCTING PROPERTIES OF $Nb_{12}Al_3Ge$ WITH VARYING CONCENTRATIONS OF NIOBIUM. Ageev, N. V.; Alekseevskii, N. E.; Shamrai, V. F. pp 17-19 of Splavy Redkikh Metallov s Osobymi Fizicheskimi Svoistvami. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

The critical temperature, critical magnetic field, and the substructure of the $Nb_{12}Al_3Ge$ compound in the ternary Nb–Al–Ge alloy with an atomic concentration ratio of Al to Ge of 3:1 were studied. The alloy had a maximum concentration of Nb of 78 at. % and a minimum concentration of 69 at. %. An excess of Nb as compared to the stoichiometric composition $Nb_{12}Al_3Ge$ causes a decrease of the critical temperature, the blurring of the boundary transition to the superconducting state, and a decrease of the critical magnetic field. An excess of Al and Ge does not cause any sharp change in the superconducting properties. The decrease of the superconducting parameters in alloys with excess concentration of Nb is explained by a change of the state of the substructure of the $Nb_{12}Al_3Ge$ compound. (tr-auth)

22465 ELECTRON STRUCTURE OF SUPERCONDUCTING METALS AND ALLOYS AND ITS CONNECTION WITH OPTICAL PROPERTIES. Motulevich, G. P.; Golovashkin, A. I.; Shubin, A. A. pp 20-24 of Splavy Redkikh Metallov s Osobymi Fizicheskimi Svoistvami. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

The relation between the optical properties of metals and their electron structure is examined. It was shown that optical measurements made in a wide spectral interval make it possible to obtain both the characteristics of the conduction electrons and the characteristics of the electrons participating in interzone transitions. The electron characteristics of the metals Nb and V and

of the alloys Nb–Sn, Nb–Ti, and V–Ga were determined by optical methods. Correlations were obtained between the electron characteristics and the superconducting parameters of these metals and alloys. (tr-auth)

22466 STUDY OF CROSS SECTIONS OF TERNARY AND QUARTERNARY SYSTEMS BASED ON SUPERCONDUCTING COMPOUNDS WITH STRUCTURE OF THE A15 TYPE. Savitskii, E. M.; Baron, V. V.; Efimov, Yu. V.; Bychkova, M. I.; Myzenkova, L. F.; Kozlova, N. D. pp 24-31 of Splavy Redkikh Metallov s Osobymi Fizicheskimi Svoistvami. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

The structure of the cross sections $V_3Ga–V_3Sn$, $V_3Ga–V_3Ge$, $V_3Ge–V_3Sn$, $Nb_3Ga–Nb_3Ge$, $Nb_3Ga–Nb_3Al$, $Nb_3Ga–Nb_3Sb$, $Nb_3Ge–Nb_3Sb$, $Nb_3Sn–V_3Ge$, and $Nb_3Al–V_3Ge$ was studied. Composition–property diagrams (transition temperature to the superconducting state, lattice constants, microhardness, and fusion temperature) were constructed. The T_c as a function of the composition of the alloys was changed additively or with negative declination (down to a minimum) from additivity. Correlations of the properties studied unique for all the alloys were not detected. (tr-auth)

22467 EFFECT OF THE SUPERCONDUCTING TRANSITION ON THE INTERNAL FRICTION AND SPECIFIC ELASTIC MODULUS OF ALLOYS OF THE NIOBIUM–TITANIUM SYSTEM. Savitskii, E. M.; Postnikov, V. S.; Zolotukhin, I. V.; Miloshenko, V. E.; Baron, V. V.; Bychkova, M. I. pp 31-35 of Splavy Redkikh Metallov s Osobymi Fizicheskimi Svoistvami. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

The effect of the superconducting transition on the internal friction and the elasticity modulus of Nb and its alloys with 25, 50, 75, and 80 at. % Ti was studied. At the temperature of the transition to the superconducting state Nb as well as its alloys with Ti displays a maximum for the internal friction. The behavior of the internal friction is explained by the presence of both normal and superconducting phases in the sample. It was discovered that the background in the superconducting state is much higher than in the normal state in strongly deformed samples. The decrease of the background level in the superconducting state is related to the decrease of the retarding effect of electrons on dislocations. At T_c the elasticity modulus changes abruptly. The size of discontinuity is connected to a significant degree to the dislocated structure of the sample. (tr-auth)

22468 ELECTRON CHARACTERISTICS OF ALLOYS OF NIOBIUM WITH TIN. Golovashkin, A. I.; Levchenko, I. S.; Motulevich, G. P. pp 35-39 of Splavy Redkikh Metallov s Osobymi Fizicheskimi Svoistvami. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

The optical and superconducting properties of alloys of Nb with Sn, obtained by vacuum evaporation, were measured. The electron characteristics were determined. Correlations were obtained for the critical temperature with the concentration of conduction electrons and for the width of the transition interval with the length of the free path of the electrons. The concentration dependence of the electron-phonon interaction was determined. (tr-auth)

22469 THERMAL EXPANSION COEFFICIENTS FOR THE SUPERCONDUCTING ALLOYS NIOBIUM–ZIRCONIUM–TITANIUM AND NIOBIUM–TITANIUM IN THE TEMPERATURE INTERVAL FROM 10 TO 300°K. Golik, V. R.; Petrenko, N. S.; Popov, V. P. pp 39-41 of Splavy Redkikh Metallov s Osobymi Fizicheskimi Svoistvami. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

The temperature dependence of the coefficients of linear expansion (a) of the superconducting deformed alloys Nb–Zr–Ti (50–25–25%) and Nb–Ti (40–60%) was measured in the temperature interval from 10 to 300°K. The values of a for Nb–Zr–Ti at temperatures of 20, 50, 100, 150, 200, and 275°K are 0.035, 0.24, 0.53, 0.64, 0.68, and 0.74 (all $\times 10^{-5}$) degree^{-1} respectively. The value of a for the binary alloys up to 100°K is close (within the limits of error of the measurement) to a for the ternary alloys and is 10% larger in the temperature interval from 100 to 300°K. The values of the specific expansion of these alloys were also determined throughout this temperature interval. (tr-auth)

22470 SUPERCONDUCTING TRANSITION IN ZIRCONIUM-RICH TERNARY SOLID SOLUTIONS OF ZIRCONIUM–MOLYBDENUM–NIOBIUM. Bychkov, Yu. F.; Mal'tsev, V. A.; Cherkasov, N. A.; Vasil'ev, N. G. pp 41-44 of Splavy Redkikh Metallov s Osobymi Fizicheskimi Svoistvami. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

The effect of the composition of the ternary alloy on the temperature of the superconducting transition, electrical resistance, and its unusual temperature dependence at low temperature was studied. In the binary alloy zirconium–molybdenum, formed with very low values of T_c (~1°K), an increase of T_c up to 6.5°K takes place. Mo alloying of the Zr–Nb alloy (with 5 to 15% Nb) also leads to an increase of T_c. The electron concentration appears to be a significant factor determining the value of T_c in the ternary bcc ternary Zr–Mo–Nb solid solution. It was shown that alloys of Zr with 8 and 10 wt.% Mo have, in the cold-deformed state, a negative temperature coefficient for the electrical resistance, but alloys with less (7%) and greater (15%) concentrations of Nb have a positive temperature coefficient of the electrical resistance close to zero. (tr-auth)

22471 USE OF THE METHOD OF SYSTEMATIZATION OF EXPERIMENTS IN THE STUDY OF SUPERCONDUCTING MULTICOMPONENT SYSTEMS. Savitskii, E. M.; Efimov, Yu. V.; Baron, V. V.; Bychkova, M. I.; Kozlova, N. D. pp 44-50 of Splavy Redkikh Metallov s Osobymi Fizicheskimi Svoistvami. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

The simplex lattice method was used to construct composition—property diagrams (T_c, H_μ, $\rho_{12°K}$, $\rho_{300°K}$, and the lattice constants) of solid solutions with bcc lattice of the quarternary system V–Nb–Ta–Ti and of A15-type solid solutions of the pseudoquarternary system $V_3Si–V_3Ga–V_3Sn–V_3Ge$. The calculations were made on the Minsk-22 computer by the equation of four degrees of approximation. Agreement of the calculated and experimental data was obtained within the limits of experimental error. T_c of the alloys of the quarternary system does not exceed the maximum value of T_c of the binary system. T_c of the pseudoquarternary alloy is higher than the critical temperature of the binary compound–component. Correlations between the properties studied were discussed. (tr-auth)

22472 EXPERIMENTAL STUDY OF THE MAGNETIZATION INTENSITY OF SOME SUPERCONDUCTING ALLOYS. Vasil'ev, N. G.; Karasik, V. R.; Bychkov, Yu. F.; Zuev, M. T. pp 50-56 of Splavy Redkikh Metallov s Osobymi Fizicheskimi Svoistvami. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

The experimental installation for eliminating the magnetization intensity M(H) curve at temperature T > 4.2°K was described. The effects of the rate of input of the current to the solenoid and of the temperature on the size of the discontinuity of the magnetic flux in the superconducting alloy Ti-22 at. % Nb were studied. The discontinuities of the magnetic flux were also observed in the alloys Zr–20% Nb and Zr–35% Nb. For the alloy Zr–20 at. % Nb, with a rigidly held Abrikosov vortex lattice, the applicability of the hypothesis of critical state was shown. (tr-auth)

22473 PRODUCTION AND STUDY OF THE T_c OF SAMPLES WITH VARIABLE COMPOSITION OF THE SYSTEMS NIOBIUM–TANTALUM, LEAD–BISMUTH, AND LEAD–INDIUM. Savitskii, E. M.; Baron, V. V.; Efimov, Yu. V.; Gindina, S. D. pp 56-59 of Splavy Redkikh Metallov s Osobymi Fizicheskimi Svoistvami. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

On massive samples of variable composition of the systems Nb–Ta, Pb–Bi, and Pb–In, prepared by the zone fusion method, the variation of T_c with the composition was studied. Composition–T_c diagrams constructed for these systems agree with known data. The method for the measurement of T_c of the superconducting systems on samples of variable composition appears to be a convenient method for physical-chemical analysis. (tr-auth)

22474 STRUCTURE AND SUPERCONDUCTING PROPERTIES OF NIOBIUM–TITANIUM–COPPER ALLOYS. Savitskii, E. M.; Baron, V. V.; Frolov, V. A. pp 60-64 of Splavy Redkikh Metallov s Osobymi Fizicheskimi Svoistvami. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

The structure and superconducting properties of alloys with a constant ratio of Nb to Ti of 2:3 and 1:3 and Cu concentration up to 8.5 at. % were studied. Isothermal cross sections at 700°C of the Ti corner of the Nb–Ti–Cu alloy were constructed. In alloys containing Cu in quantities with a large extent of solubility, the formation of inclusions of a nonsuperconducting phase the compound Ti_2Cu was observed in the β solid solution. This leads to a significant increase of the density of the critical current. (tr-auth)

22475 SUPERCONDUCTING PROPERTIES AND PHASE COMPOSITION OF NIOBIUM–GALLIUM ALLOYS. Kruglov, V. S.; Bychkov, Yu. F.; Rozanov, A. N.; Yakovlev, E. I.; Cherkasov, N. A. pp 64-68 of Splavy Redkikh Metallov s Osobymi Fizicheskimi Svoistvami. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

The dependence of the temperature of superconducting transition of the Nb–Ga alloy on the composition was studied in a wide concentration interval and as a function of the thermal processing. All compounds of the Nb–Ga system except Nb_3Ga do not have superconductivity above 2°K. The experimental data was treated

by means of a proposed new form of phase diagram for the Nb_3Ga region. On the basis of this phase diagram it was shown that the solubility of Ga in Nb_3Ga increases with increase of the temperature. The superconducting transition temperature depends to a larger degree on the composition of the intermediate A15-type phases than on other factors. The stoichiometric composition (25 at.% Ga) of the Nb_3Ga compound occurs at the limits of the equilibrium region of Nb_3Ga. The maximum T_c for Nb_3Ga obtained was 16.8°K. (tr-auth)

22476 EFFECT OF AN ULTRAHIGH COOLING RATE ON THE TEMPERATURE OF TRANSITION TO THE SUPERCONDUCTING STATE IN Sn–In AND Pb–Sn ALLOYS. Salli, I. V.; Dzenzerskii, V. A.; Sokolov, V. V.; Gubin, V. V.; Evina, T. Yu.; Tremba, T. S.; Trikoz, Yu. K. pp 68-70 of Splavy Redkikh Metallov s Osobymi Fizicheskimi Svoistvami. Savitskii, E. M. (ed.). Moscow, Izdatel'stvo Nauka (1974). (In Russian).

A description is given of the method for obtaining an ultrahigh cooling rate for melts (~10^7 °/sec) by sudden closing of the melt drop between two copper foils which are cooled to the temperature for the boiling of liquid nitrogen. The structure of the Sn–In and Sn–Pb alloys was studied in a wide concentration interval and the transition temperature to the superconducting state in foils freshly quenched and heated up to room temperature was determined. (tr-auth)

22477 EXPERIMENTAL STUDY OF THE SURFACE SUPERCONDUCTIVITY OF THE Ti–22 at. % Nb ALLOY. Vasil'ev, N. G.; Karasik, V. R.; Mal'tsev, V. A.; Seferov, A. S.; Cherkasov, N. A. pp 71-75 of Splavy Redkikh Metallov s Osobymi Fizicheskimi Svoistvami. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

The experimental dependence of the critical current of surface superconductivity on the external magnetic field was compared with the theoretical dependence i_c (H) for the model alloy Ti–22 at. % Nb with a rigidly held Abrikosov vortex lattice. The effect of the surface state on the size of the critical current of the surface conductivity was studied. The lack of any effect from the surface processing on the critical currents H_{K_2} and H_{K_1} was shown. (tr-auth)

22478 SUPERCONDUCTING PROPERTIES OF MULTISTRAND COMPOSITION SUPERCONDUCTORS OF NIOBIUM–TITANIUM ALLOY IN A COPPER MATRIX. Savitskii, E. M.; Baron, V. V.; Frolov, V. A.; Bychkova, M. I. pp 83-85 of Splavy Redkikh Metallov s Osobymi Fizicheskimi Svoistvami. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

A process was developed for the fabrication of multistrand composition superconductors with fine strands of Nb–Ti alloy in a Cu matrix. Its superconducting properties were studied. The number of superconducting strands was 7, 19, 37, and 133, their gauge was 20 to 90 μ, and the total diameter of the composition superconductor was 0.3 mm and larger. The effect of the processing temperature and the strand dimensions on the superconducting characteristics of the material was studied. After thermal processing in an optimum regime the conductors have H_{K_2} 100 kOe and T_c = 8.8°K. In a field of 50 kOe at 4.2°K i_c goes up to 2×10^5 amp/cm² according to the superconductor and up to 4×10^4 amp/cm² at all cross sections. (tr-auth)

22479 EFFECT OF THE PROCESSING REGIME ON THE STRUCTURE AND SUPERCONDUCTING PROPERTIES OF Nb_3Sn-COATED STRIPS. Savitskii, E. M.; Enman, V. K.; Mikhailov, E. P.; Baron, V. V.; Krainskii, I. S.; Tregubov, V. N. pp 85-88 of Splavy Redkikh Metallov s Osobymi Fizicheskimi Svoistvami. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

The effect of the processing regime (temperature of the Sn bath, reaction time for the Nb strips with Sn, composition of the medium, and different methods of thermal processing) on the phase composition, thickness, density, uniformity, and superconducting properties of Nb_3Sn-coated strips was studied. The optimum temperature interval of the Sn bath (940 to 960°) was established. It was shown that prolonged thermodiffusion annealing substantially increases the thickness of the Nb_3Sn layer and leads to an increase of the critical current. On the basis of microstructural studies changes in the character of the formation of Nb_3Sn layers during the continuous process was noted because of instabilities in the composition of the Sn bath. It was shown that the use of the method of light etching permits a simple and reliable correction of the processing in order to obtain strips with high superconducting parameters. (tr-auth)

22480 CRITICAL BEHAVIOR OF A CHARGED BOSE GAS. Bishop, R. F. (Manchester Univ., Eng.). J. Low Temp. Phys.; 15: No. 5/6, 601-635(Jun 1974).

A fully self-consistent Hartree–Fock theory, using the Coulomb interaction screened by the polarization insertions calculated in the self-consistent random-phase approximation, is applied to the d-dimensional, dense, charged Bose gas at temperatures close to the transition temperature T_c. The quasiparticle energy spectrum is calculated and shown to behave at T_c like $\epsilon(k) = Ak^\sigma$ for small k, and σ is calculated as a function of the dimensionality d. The change in transition temperature from that of an ideal gas at the same density, and of the chemical potential are shown to be given by $(T_c - T_{c0})/T_{c0} \approx Xr_s^{(d-2)/3}$ and $\mu_c \approx Yr_s^{2/3}$, where r_s is the ratio of the interparticle spacing to the Bohr radius. Approximate expressions are given for the coefficients X and Y. The critical exponents are calculated, and the system is shown to obey exact scaling. (auth)

22481 FLUX DENSITY DISTRIBUTION IN LOW-K TYPE II SUPERCONDUCTORS. Riegler, R.; Weber, H. W. (Atominstitut der Oesterreichischen Hochschulen, Vienna). J. Low Temp. Phys.; 15: No. 5/6, 431-445(Jun 1974).

Measurements of the flux density distribution recorded directly with several microfield probes are reported. For weakly hysteretic samples marked differences of the profiles in increasing and decreasing fields are observed and attributed to the influence of the reversible magnetization. The evaluation of bulk pinning forces shows a shift of the maximum toward higher inductions with increasing defect concentration and a scaling of the field dependence with temperature. The disappearance of pinning forces well below H_{c2} is analyzed in terms of the threshold criterion. An evaluation of the basic pinning forces shows that elasticity effects of the flux line lattice may not be neglected, although large precipitates (~2 μm) are the main pinning sites. An identification of the basic pinning mechanism is complicated by the presence of dislocations around the precipitates. (auth)

22482 MEASUREMENTS OF THE RELAXATION OF QUASIPARTICLE BRANCH IMBALANCE IN SUPERCONDUCTORS. Clarke, J.; Paterson, J. L. (Univ. of California, Berkeley). J. Low Temp. Phys.; 15: No. 5/6, 491-522(Jun 1974).

An imbalance Q in the quasiparticle populations of the $k > k_F$ and $k < k_F$ branches of a superconductor may be generated by the injection of a current through a tunnel barrier. This imbalance relaxes with a characteristic time τ_Q. The steady-state value of Q gives rise to a quasiparticle potential V that differs from the pair chemical potential, and which may be measured by a second tunnel junction. Tinkham's theory of these effects is briefly reviewed. Detailed experimental results are presented for tin. Most of the data are for injection voltages much greater than the energy gap $\Delta(T)$. Close to the transition temperature T_c, Q relaxes by inelastic phonon scattering, and $\tau_Q^{ph} = (1.0 \pm 0.2) \times 10^{-10}\, \Delta(0)/\Delta(T)$ sec. This time is about one-half that estimated by Tinkham. At temperatures somewhat below T_c, elastic scattering also contributes to the Q relaxation, provided the superconducting energy gap is anisotropic. With a size-effect-limited mean free path of about 2800 Å, we find $\tau_Q^{el} \approx 1.4 \times 10^{-10}$ sec for $T/T_c < 0.6$, a value that is also in good agreement with Tinkham's theory. In a sample with a mean free path of 420 Å, and a greatly reduced anisotropy, τ_Q^{el} was increased to about 10^{-9} sec. Data were also taken for injection voltages close to $\Delta(T)/e$. The degree of imbalance per unit injection current was greatly reduced, as predicted by the theory. Preliminary measurements were made on lead. At 4.2 K (T/T_c = 0.58) the characteristic time was about 3×10^{-12} sec. The quasiparticle potential apparently increased steadily as the temperature was lowered, probably indicating that the characteristic time also increased. This result is not well understood. However, it is possible that recombination processes play a role in the Q relaxation in lead. (auth)

22483 CONCENTRATION EFFECTS IN THE CRITICAL TEMPERATURE OF SUPERCONDUCTING ALLOYS: FUNCTIONAL INTEGRAL METHOD. Theumann, A. (Univ., Paris). J. Low Temp. Phys.; 15: No. 5/6, 547-558(Jun 1974).

The critical temperature T_c of a dilute superconducting alloy with transition metal impurities is calculated as a function of the concentration of impurities within the framework of the functional integral formalism. By limiting ourselves to the static approximation, an expression is obtained for $\log (T_c/T_0)$ that reduces to known results in the magnetic and nonmagnetic limits, thus having the character of an interpolating formula between these two extreme cases. (auth)

22484 SURFACE IMPEDANCE OF CLEAN TYPE II SUPERCONDUCTORS. Cerdeira, H. A. (Max-Planck Institut fuer Festkoerperforschung, Stuttgart); Houghton, A.; Maki, K. J. Low Temp. Phys.; 15: No. 5/6, 577-581(Jun 1974).

The surface impedance of clean type II superconductors is calculated in fields near H_{c2}. A marked dependence of the surface impedance on mean free path l, is predicted which is consistent with experiment. The dependence of the surface impedance on the direction of propagation of the microwave is also discussed. (auth)

22485 EFFECT OF INTERCALATE AND LAYER PROPERTIES ON SUPERCONDUCTING TRANSITION METAL DICHALCOGENIDES. Meyer, S. F. Palo Alto, CA; Stanford Univ. (1974). 128p. University Microfilms Order No. 74-13,660.

Thesis (Ph. D.).

A brief review of the studies on intercalated materials is provided along with a basic description of the crystal structures of the materials. The Acrivos theory of charge transfer stabilization of intercalation complexes is presented and compared with some experimental studies. The conventional thermal reaction method of intercalation has been extended to additional systems and phases of layered materials. The compounds formed have been characterized in terms of crystal structure, heat capacity, and resistivity, and compared with existing knowledge of previously studied systems. A new electrolytic technique for intercalation of metals from ammonia solution using metal halide salts has been developed. The electrolytic method has been used to study the effect of quasi-continuous variation of intercalate properties of the transition temperature. The electrolytic intercalation of hydrogen from acid solution has been found to raise the bulk superconducting transition temperature in tantalum disulfide with very small concentrations of hydrogen. The resistivity, crystal structure, specific heat, and susceptibility of the compound have been investigated for changes relative to the unintercalated material. The details of the ac susceptibility apparatus, low temperature x-ray procedure for unstable samples, and electrolytic cell construction and sample preparation are discussed in the three appendices. (Diss. Abstr. Int., B)

22486 SPECIFIC HEAT OF SUPERCONDUCTORS NEAR THE TRANSITION TEMPERATURE. Imbro, D. R. Riverside, CA; University of California (1973). 94p. University Microfilms Order No. 74-13,569.

Thesis (Ph. D.).

It is well known that the phenomenological theory of Ginzburg and Landau predicts a discontinuity in the specific heat of superconductors at the transition temperature, T_c. However, the qualitative effects of statistical fluctuations of the order parameter, Ψ, on the superconducting contribution to the specific heat, δC_v, has been the subject of several works with contradictory results. Whereas some calculations and measurements on films indicate the quantity $\delta C_v/(T/T_c)$ is a monotonic function of temperature most calculations predict it will be peaked near T_c. The theory of Ginzburg and Landau is reviewed and it is noted that even with fluctuations included the internal energy, E, is simply related to the free energy functional. δC_v was calculated from E rather than from approximations to the free energy or entropy as done by others. In zero dimensional samples the spatial variations of the order parameter are neglected and E may be calculated easily. It is found that $\delta C_v/(T/T_c)$ is indeed a monotonic function of temperature. In one and two dimensional systems it is necessary to adopt approximations for the correlation functions $\langle\Psi(x)\Psi(x')\rangle$ and $\langle\delta\Psi^2(x)\delta\Psi^2(x')\rangle$ where $\delta\Psi^2 = \Psi^2 - \langle\Psi^2\rangle$. Within these approximations it is found again that $\delta C_v/(T/T_c)$ is monotonic in T. An important approximation is the assumption that since fluctuations are important only very close to T_c one may replace $\beta = (k_B T)^{-1}$ by its value at the transition temperature, β_c. This approximation is made when calculating the internal energy in one and two dimensional systems. It is shown that when this approximation is made in the partition function $\delta C_v/(T/T_c)$ can never be peaked. (Diss. Abstr. Int., B)

22487 CRITICAL BEHAVIOR OF DYSPROSIUM. Craven, R. A. Rochester, NY; University of Rochester (1974). 162p. University Microfilms Order No. 74-14,389.

Thesis (Ph. D.).

Measurements have been made of the resistivity, lattice expansion, and stress-induced resistivity along the c-axis of a single crystal of dysprosium in zero applied field. The effects of large magnetic fields, applied parallel and perpendicular to the c-axis, on the resistivity and lattice expansion have also been measured. Analysis of the resistivity in the vicinity of the Neel temperature T_N has shown that the prediction of Suezaki and Mori, that the derivative of the resistivity R along the c-axis should reflect the long range behavior of the correlation function, is in agreement with the experimental results. A divergence of the form $(1/R)(dR/dT) \sim \epsilon^{-0.30}$, where $\epsilon = (T - T_N)/T_N$, was observed for $T > T_N$. For $T < T_N$ the resistivity increased with decreasing temperature reflecting the appearance of phonon-smeared, induced gaps in the electronic density of states at the Fermi surface. The coefficient of thermal expansion $(1/L)(dL/dT)$ diverged less rapidly than the resistivity, namely, $(1/L)(dL/dT) \sim \epsilon^{-0.11\pm0.015}$ for both $T > T_N$ and $T < T_N$. The coefficient of stress-induced resistivity was measured, and the resulting value, $(L/R)(dR/dL) = 4.4$, when multiplied by the thermal expansion, was found to be at least an order of magnitude smaller than the total anomalous resistivity. The magnetic field studies showed that the Néel temperature was suppressed proportional to the square of the field applied parallel to the c-axis, $dT_N/dH^2 = -1.09 \times 10^{-3}$ K/(KOe)^2. For fields applied perpendicular to the c-axis an inflection point in the resistivity and the lattice expansion indicated the appearance of a new magnetic phase whose transition temperature increased with applied field. (Diss. Abstr. Int., B)

22488 SOME SUPERCONDUCTING AND NORMAL STATE PROPERTIES OF NIOBIUM NITRIDE THIN FILMS. Jones, H.; Fischer, O.; Bongi, G. (Univ., Geneva). Solid State Commun.; 14: No. 11, 1061-1064(1 Jun 1974).

The temperature dependence of the resistance, the superconducting transition temperature, and the upper critical field of niobium nitride thin films were measured. The samples were made by sputtering in a nitrogen-argon ion beam. The pressure during deposition is typically one to two orders of magnitude lower than that of standard sputtering techniques. (auth)

22489 EFFECT OF SCATTERING AT THE NORMAL-SUPERCONDUCTING INTERFACE ON THE MAGNETORESISTIVITY OF A TYPE-I SUPERCONDUCTOR (TIN). Ho, D. L. Toronto; University of Toronto (1972). National Library of Canada, Ottawa.

Thesis (Ph. D.).

The transverse and Hall resistivities were measured in the intermediate state of a type-I superconductor (tin), using a dc technique and a helicon wave resonance technique. Below 3K, the transverse dc differential resistance in the intermediate state was found to vary linearly with the external field in field orientations such that the magnetoresistance in the normal state is linear at low fields and subsequently saturates at higher fields (low magnetoresistance). With the field along [010] and the current along [100], the magnetoresistance in the normal state is quadratic with the external field (high magnetoresistance), and the dc differential resistance in the high reduced field regime dropped below the usual linear variation with the external field. The decrease below the linear variation of the dc resistance with the external field was observed to increase as the temperature was lowered from 3K to 1.5K, and was concluded to be due to a decrease of the quadratic magnetoresistivity in the intermediate state. Measurements of resistivities by the helicon wave resonance technique, with the field along the low and high magnetoresistance directions respectively, also confirmed that only the high magnetoresistivity decreased significantly in the high reduced field regime. The Hall resistivities decreased in the intermediate state. The tangent of the Hall angle was found to decrease in the dc experiments, while it increased slightly or stayed constant, depending on the field orientation, in the helicon wave resonance experiments. It is proposed that the decrease in the magnetoresistivity is due to the presence of diffuse scattering at the normal-superconducting interface, in addition to the idealized "Andreev reflection." From the dc experimental data, it was deduced that a small fraction (~15%) of the electronic excitations suffer diffuse scattering at the normal-superconducting interface, and hence do not contribute as much to the magnetoresistivity of the normal regions in the intermediate state. (Diss. Abstr. Int., B)

22490 SUPERCONDUCTING PROPERTIES OF Nb_3Sn WITH HIGH CARBON DOPING. Ziegler, G. (Siemens A.G., Erlangen (F.R. Germany). Forschungslaboratorium). Z. Naturforsch., A; 28: No. 2, 318-319(Feb 1973).

1 figure; 1 table; 2 references.

The superconducting compound Nb_3Sn was heavily doped with carbon during chemical vapor deposition and then annealed. Very high current carrying capacities could be attained by this method (3.2×10^6 A/cm^2 at 5 T). (auth)

22491 SUPERCONDUCTIVITY WITH ONSET ABOVE 23°K IN Nb–Ge SPUTTERED FILMS. Testardi, L. R.; Wernick, J. H.; Royer, W. A. (Bell Telephone Labs., Inc., Murray Hill, NJ). Solid State Commun.; 15: No. 1, 1-4(1 Jul 1974).

Sputtered films of nominal composition Nb_3Ge deposited onto hot substrates, of the type recently found by Gavaler to have superconductivity onsets at 22.3°K, have now been obtained with a maximum onset temperature of 23.2 ± 0.2°K and a transition width of ~1.2°K. The sputtering conditions necessary to achieve these results are discussed and suggest that the high T_c phase may be detrimentally affected by the presence of high energy particles present under normal sputtering conditions. (auth)

22492 PROGNOSIS FOR SUPERCONDUCTIVITY IN Np AND Pu. Hill, H. H.; White, R. W.; Lindsay, J. D. G.; Struebing, V. O. (Los Alamos Scientific Lab., NM). Solid State Commun.; 15: No. 1, 49-51(1 Jul 1974).

Np and Pu were substituted for U in bcc γ–U alloys and the depression of T_c measured. By extrapolating the Np and Pu impurity concentrations to 100%, estimates were made for the maximum superconducting transition temperatures that may be expected for bcc γ–Np and ϵ–Pu alloys. (auth)

22493 ELECTRON TUNNELLING STUDY OF THE SUPERCONDUCTING HIGH-PRESSURE PHASE OF Bi. Nedellec, P.; Dumoulin, L.; Noer, R. J. (Univ., Paris). J. Phys., F (London); 4: No. 6, L145-L150(Jun 1974).

The high-pressure superconducting phase of evaporated Bi films was studied by electron tunnelling, using Schottky barriers. The values of the transition temperature, energy gap and phonon energies of Bi III are very similar to those for Pb and for amorphous Bi. A comparative discussion of the strong coupling superconductivity in these materials is given. (auth)

22494 THEORY FOR STRONG-COUPLING SUPERCONDUCTIVITY IN TRANSITION-METAL ALLOYS. Kerker, G.; Bennemann, K. H. (Freie Univ., Berlin). Solid State Commun.; 15: No. 1, 29-33(1 Jul 1974).

Strong-coupling superconductivity in transition-metal alloys of the type A_xB_{1-x} is treated by applying the coherent-potential approximation to the Eliashberg theory of superconductivity. Expressions are given for the average electron-phonon coupling constant λ_{eff}, the average Coulomb-pseudopotential μ^*_{eff}, the superconducting transition temperature T_c, and the order parameter. (auth)

22495 KINETIC THEORY OF INTERMEDIATE STATE OF SUPERCONDUCTORS. Galaiko, V. P.; Bezuglyi, E. V.; Puppe, E. (Physical-Technical Inst. of Low Temperatures, Kharkov). Fiz. Metal. Metalloved.; 37: No. 3, 479-488(Mar 1974). (In Russian).

Using the general method of kinetic equations in semiconductor theory, kinetic equations were derived and limiting conditions were found for the dispersion function of normal electron activation, localized in the normal layers of the intermediate state of a superconductor. The use of the equations obtained is illustrated by calculation of kinetic coefficients of the intermediate state. (tr-auth)

22496 TEMPERATURE DEPENDENCE OF SOFTENING EFFECT IN TWO-ZONE SUPERCONDUCTORS. Druinskii, E. I.; Fal'ko, I. I. (Kharkov State Univ.). Fiz. Metal. Metalloved.; 37: No. 3, 646-647(Mar 1974). (In Russian).

Plotted data show a qualitative divergence between theoretical for a one-zone model and experimental values of softening of 99.97% Mo as a function of temperature. Agreement is better if a two-zone model is used, but accurate comparison cannot be made because of the considerable scatter in the data. (tr-auth)

22497 ARRANGEMENT AND MOTION OF INDIVIDUAL MAGNETIC FLUX QUANTA IN TYPE I THIN LAYER SUPERCONDUCTORS. Lischke, B.; Rodewald, W.; Soellig, H. (Technische Univ., Berlin). pp 389-395 of Physik 1973. Weinheim, Ger.; Physik Verlag GmnH (1973). (In German)

From thirty-seventh physicists conference; Hamburg, F. R. Germany (24 Sep 1973). See CONF-730993-.

The magnetic flux-filled region in thin superconducting layers (Pb, In) in perpendicular magnetic fields was made visible by etching with Fe particles. Under a critical thickness of about 0.1 m the two-dimensional mixed state actually exists as the Tinkham theory proposes. For the study of the dynamics of the individual magnetic flux lines in the superconductors (Pb, Pb-In) a vortex microscope was developed and the motion of an individual flux quantum in a superconducting thin layer was studied. The motion occurs in agreement with the Anderson model in very small jumps between pinning centers and is thermally activated. The interaction of individual flux lines with pinning centers can be studied with both methods. (tr-auth)

22498 EFFECT OF ZONE STRUCTURE ON SUPER-CONDUCTING PROPERTIES OF Ti_x-Nb_{1-x} ALLOYS. Prekul, A. F.; Rassokhin, V. A.; Volkenshtein, N. V. (Inst. of Physics of Metals, Moscow). Fiz. Metal. Metalloved.; 37: No. 3, 671-672(Mar 1974). (In Russian).

Data indicate the presence of two types of conductors with different effective masses capable of superconducting condensation. This may be the source of anomalous behavior of thermal capacity observed in alloys at temperatures below critical. (MG)

22499 ENTROPY OF A TYPE-II SUPERCONDUCTOR CLOSE TO THE CRITICAL TEMPERATURE. Ehrat, R.; Rinderer, L. (Univ., Lausanne, Switzerland). Helv. Phys. Acta; 46: No. 5, 697-719(1973).

The experimental values for the incremental entropy, $S_i = \phi_0(\partial S/\partial B)|_T$, of vortices in the mixed state, have been determined for the alloy Nb80Mo20 ($K \approx 4$). From specific heat data for $C_s(T)$ in the superconducting state and $C_n(T)$ in the normal state, this alloy is shown to behave as a BCS superconductor. The results for $S_i(B)$ are compared with theoretical values deduced from the Abrikosov free energy at high fields, extended to arbitrary temperatures, and from the London energy at low fields. Integrating $S_i(B)$, the experimental entropy curves at constant induction, $S(T)|_B$, can be constructed and experimental values for C_B, the specific heat at constant induction, are indirectly obtained from graphical differentiation. At the mixed-normal phase transition and close to T_c, the results suggest that C_B is continuous and tends to $C_s(T_c)$, in contradiction to the theoretical predictions. This is in thermodynamic agreement with anomalous results for C_H already obtained on the same sample. The consequences of this new information are analyzed. (auth)

22500 TEMPERATURE DOMAINS IN SUPERCONDUCTOR FILMS. Volkov, A. F.; Kogan, Sh. M. (Inst. of Radio Engineering and Electronics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 19: No. 1, 4-6(5 Jan 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 19: No. 1, 9-12(5 Jan 1974).

It is shown that temperature domains can be produced in thin superconductor films as a result of the released Joule heat. The possible types of domains and their shapes are determined, and the current-voltage characteristics of the film are found with allowance for domain formation. (auth)

22501 OBSERVATION OF SUPERCONDUCTING CURRENT EXCITED IN A SUPERCONDUCTOR BY HEAT FLOW. Zavaritskii, N. V. (Inst. of Physics Problems, Moscow). JETP Lett. (USSR) (Engl. Transl.); 19: No. 4, 126-128(20 Feb 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 19: No. 4, 205-208(20 Feb 1974).

It has been observed experimentally that a temperature gradient produces flow of superconducting current in a circuit made up of superconductors. The dependence of the effect on the temperature and on the characteristics of the superconductor is investigated. (auth)

22502 EFFECT OF COLD WORK AND HEAT TREATMENT ON THE SUPERCONDUCTING PROPERTIES OF Nb-Ti ALLOY. Chao, Y. L.; Chang, K. H.; Yang, T. Y.; Wang. W. U. Wu Li Hsueh Pao; 23: No. 1, 77-80(24 Jan 1974). (In Chinese).

The Nb-Ti alloy has a $H-J_c$ (external magnetic field intensity-critical current density) characteristic which facilitates processing, and enables us to obtain a high degree of stability in the alloy's superconductivity. Among the three critical characteristics, T_c (critical temperature), H_c (critical magnetic intensity) and $H-J_c$, the first two are insensitive and the third is sensitive and subject to the effects of cold work and heat treatment. Therefore, the $H-J_c$ characteristic is the main indication of the superconductivity of certain Nb-Ti alloys. When the electric current exceeds J_c, a jump occurs in magnetic flux, and the alloy is changed from a superconducting state to the normal state. Defects in crystal lattice resulting from cold work or heat treatment may have a pegging effect on the magnetic flux jump. An optimal pegging effect may be obtained by selecting the proper cold work heat treatment methods. The effect of cold work and heat treatment on the $H-J_c$ superconducting characteristic of Nb-54 wt % Ti alloy and Nb-58 wt% Ti alloy are discussed. The results show that the main factors determining the $H-J_c$ characteristic are the number, dimension and distribution of the dislocated phases. The heat treatment before the cold work has a great effect on the number, dimension and distribution of dislocated phases resulting from subsequent heat treatments. (JPRS)

22503 PHASE TRANSITIONS IN RESERVOIR-DRIVEN OPEN SYSTEMS WITH APPLICATIONS TO LASERS AND SUPERCONDUCTORS. Hepp, K. (Eidgenoessische Technische Hochschule, Zurich); Lieb, E. H. Helv. Phys. Acta; 46: No. 5, 573-603(1973).

A class of mean field model Hamiltonians consisting of a small, but macroscopic system S of N components interacting with a large reservoir R. The Dicke model of a laser is a particular example of S. Both R and S are fully quantum mechanical. The exact equations of motion are studied, and it is shown that it is possible to eliminate the reservoir variables and, in the limit $N \to \infty$, to derive closed equations for the extensive variables of S. These equations are classical, and the effect of the reservoir is to provide damping and driving (or pumping) terms. As the parameters of the system are varied, S can undergo phase transitions in the sense that its equilibrium orbits bifurcate. To the next order, $N^{\frac{1}{2}}$, the reservoir drives the fluctuation observables of S linearly with Markovian, Gaussian random forces. Within the context of the class of models the results are rigorous and are obtained without any approximation. (auth)

22504 SPECIFIC HEAT OF TETRATHIOFULVALINIUM-TETRACYANOQUINODIMETHANE (TTF-TCNQ) IN THE VICINITY OF THE METAL-INSULATOR TRANSITION. Craven, R. A. (Univ. of Illinois, Urbana); Salamon, M. B.; DePasquali, G.; Herman, R. M.; Stucky, G.; Schultz, A. Phys. Rev. Lett.; 32: No. 14, 769-772(8 Apr 1973).

Measurements of the specific heat of tetrathiofulvalinium-

tetracyanoquinodimethane have been made from 45 to 70°K using ac calorimetric methods. A steplike anomaly in the specific heat is observed with transition temperature 54.8°K. The results compare favorably with predictions from a mean-field model when the crystal undergoes a Peierls distortion. (auth)

22505 VALENCE ELECTRONIC STRUCTURE AND CHARGE TRANSFER IN TETRATHIOFULVALINIUM TETRACYANOQUINODIMETHANE (TTF–TCNQ) FROM PHOTOEMISSION SPECTROSCOPY. Grobman, W. D.; Pollak, R. A.; Eastman, D. E.; Maas, E. T. Jr.; Scott, B. A. (IBM Watson Research Center, Yorktown Heights, NY). Phys. Rev. Lett.; 32: No. 10, 534-537(11 Mar 1974).

Comparison of ultraviolet-photoemission, valence-orbital spectra (as well as high-resolution, x-ray photoemission, N-core-level spectra) of TTF-TCNQ, neutral TCNQ, and $K^+(TCNQ)^-$ indicates a large amount of charge transfer in TTF-TCNQ. The spectra for this complex show strong coupling between states near the Fermi energy and molecular vibrations due to localization of the mobile electrons on individual molecules, at least on the time scale of bond vibrations. (auth)

22506 FLUCTUATION CONDUCTIVITY AND LATTICE STABILITY IN ONE DIMENSION. Luther, A. (Harvard Univ., Cambridge, MA); Peschel, I. Phys. Rev. Lett.; 32: No. 18, 992-995 (6 May 1974).

We calculate the effects of long-wavelength fluctuations on the electrical conductivity and lattice stability of a quasi-one-dimensional metal. Attractive interactions stabilize the lattice and cause a conductivity divergence at zero temperature. These results are exact and can be related to problems in two-dimensional relativistic quantum field theory. (auth)

22507 *ENERGY SPECTRUM OF COLLECTIVE EXCITATIONS* IN THE THEORY OF SUPERCONDUCTIVITY. De Angelis, G. F.; Mancini, F. (Univ., Salerno, Italy). Lett. Nuovo Cim.; 10: No. 15, 654-656(10 Aug 1974).

The result of a computation at T = 0°K of the boson energy in the entire region of momenta is presented. (MHR)

22508 SUPERCONDUCTING PROPERTY OF UNIDIRECTIONALLY SOLIDIFIED Pb–Sn EUTECTIC. Yue, A. S.; Chang, Y. W.; Mathur, M. P. (Univ. of California, Los Angeles). pp 79-83 of Conference on in situ Composites. Vol. III. Washington, DC; National Academy of Sciences (1973).

From conference on in situ composites; Lakeville, Connecticut, USA (5 Sep 1972). See NMAB-308-3; CONF-7209117-P3.

The critical currents vs external magnetic fields for a unidirectionally solidified Pb–Sn eutectic have been measured at 2.5, 3.0, 3.5 and 4.2°K. The values of the critical fields (H_c) at zero critical currents were obtained by extrapolation. From these data, a plot of critical field (H_c) against temperature (T) was obtained. The H_c vs T curve fits into a parabolic equation, obtained from an IBM-360 least square program. The critical temperature, T_c, at zero field was found to be 6.8°K. On the basis of thermometry, the critical temperature T_c of the Pb–Sn eutectic has been determined experimentally by cooling and warming the sample. The critical temperature was found to be 7.4 ± 0.2°K. On the basis of the relationship between the sample voltage and external magnetic field, it is concluded that the unidirectionally solidified Pb–Sn eutectic is a Type-II superconductor. This conclusion is further supported by the magnetization measurements. (auth)

22509 PREPARATION, STRUCTURE, AND SUPERCONDUCTING PROPERTIES OF THE LEAD–TIN LAMELLAR EUTECTIC. Guinier, A. (Univ., Paris); Petipas, C.; Sauvage, G.; Baixeras, J.; Dupart, J. M.; Fournet, G.; Fontaine, G.; Blanchin, M. G.; Turpin, M.; Racek, R. pp 85-96 of Conference on in situ Composites. Vol. III. Washington, DC; National Academy of Sciences (1973).

From conference on in situ composites; Lakeville, Connecticut, USA (5 Sep 1972). See NMAB-308-3; CONF-7209117-P3.

A study has been undertaken of the superconducting properties of the lead–tin eutectic on perfect lamellar structures. Such structures have been obtained by unidirectional solidification of ribbon specimens at growth rates ranging from 0.3 to 30 mm/h. The influence of temperature and time on the composition of the lead-rich lamellae has been studied by scanning electron microscopy and X-ray diffraction techniques. Preliminary results on the pinning of vortices and on the Josephson effect are given, and the influences of the interlamellar spacing and the composition of the lead-rich lamellae are discussed. (auth)

22510 FLUCTUATION CONDUCTIVITY OF SUPERCONDUCTORS OF THE SECOND KIND IN STRONG ELECTRIC AND MAGNETIC FIELDS ABOVE T_c. Cheishvili, O. D. (Inst. of Physics, Tbilisi, USSR). Zh. Eksp. Teor. Fiz.; 66: No. 5, 1862-1869(May 1974). (In Russian).

The fluctuation correction to the conductivity above the superconductivity transition temperature is investigated for impure superconductors in stationary electric and magnetic fields. The fluctuation conductivity is calculated for a massive sample located in mutually parallel or perpendicular electric and magnetic fields. The fluctuation conductivity of a thin film in perpendicular fields is also calculated. Asymptotic values of the conductivities in strong fields are obtained. (auth)

22511 NONEQUILIBRIUM STATE OF SUPERCONDUCTORS WITH OPTICALLY EXCITED QUASIPARTICLES. Elesin, V. F. (Moscow Inst. of Engineering-Physics). Zh. Eksp. Teor. Fiz.; 66: No. 5, 1755-1761(May 1974). (In Russian).

The energy distribution of nonequilibrium quasiparticles in a semiconductor is studied by means of the kinetic equation. The quasiparticles are produced on absorption of an electromagnetic field with a frequency exceeding the doubled value of the superconducting gap. The magnitude of the superconductor gap is calculated for the nonequilibrium state. With increase of field amplitude the gap decreases and in some cases may vanish at the critical field value. It is shown that the nature of the quasiparticle distribution function significantly depends on the dependence of the electron–phonon interaction matrix element on the wave vector. For certain dependences such that $M_q^2 \sim q$ (atomic crystal), $M_q^2 \sim$ const (deformation potential) or $M_q^2 \sim 1/q$ the distribution function is less than half ($n_\epsilon < 1/2$). This signifies the absence of population inversion for arbitrary field amplitudes. (auth)

22512 MICROWAVE DEPENDENCE OF SUBHARMONIC GAP STRUCTURE IN SUPERCONDUCTING JUNCTION. Soerensen, O. H.; Kofoed, B.; Pedersen, N. F.; Shapiro, S. (Technical Univ., Lyngby, Denmark). Phys. Rev., B; 9: No. 9, 3746-3756(1 May 1974).

Experiments on both point-contact junctions (Nb/Nb) and on small area thin-film tunnel junctions (Sn/O/Sn) show that applied 4-mm radiation produces *satellites associated with "subharmonic" gap* structure as well as the familiar microwave-assisted tunneling structure associated with the superconducting energy gap itself. The location in voltage of all these structures is given by eV = $(2\Delta \pm nh\nu)/m$, where 2Δ is the superconducting energy gap, ν is the applied frequency, h is Planck's constant, e is the magnitude of the electronic charge, V is the dc voltage drop across the junction, and m and n are integers: m = 1,2,3,... and n = 0.1.2..... The power dependence of the satellite structure and the microwave-assisted tunneling structure is consistent for all junctions tested with the expression J_n^2 ($meV_{rf}/h\nu$), where $J_n(x)$ is the ordinary Bessel function of order n, V_{rf} is the amplitude of the induced microwave voltage drop across the junction, and the other quantities are as defined above. A distinction between the explanations — multiparticle tunneling and nonlinear self-coupling — of the subharmonic gap structure cannot, however, be made on the basis of the observed power dependence. Hence other properties such as relative amplitude and line shape are considered and it is concluded that self-coupling mechanisms seem able to account for all the observations, whereas multiparticle tunneling may be discarded as the sole explanation of the structure. (auth)

22513 INVESTIGATION OF ELECTRON DENSITIES OF STATES IN SUPERCONDUCTING TRANSITION METALS WITH NONMAGNETIC IMPURITY. Botoshan, N. I.; Vladimir, M. I.; Moskalenko, V. A. (Inst. of Applied Physics, Kishinev, USSR). Teor. Mat. Fiz.; 19: No. 3, 371-389(Jun 1974). (In Russian).

Densities of electron states of superconducting transition metals with nonmagnetic impurity are calculated in all the frequency interval for limiting cases $\alpha_2 \ll 1$, $\alpha_1 \sim 1$ and $\alpha_1 \gg 1$, $\alpha_2 \sim 1$ at $\zeta < 1$. Within these assumptions about the parameters α_n and ζ, the expressions for the energy gap ω_g are obtained and the densities of electron states $n_n(\omega)$ of both zones are investigated in detail in their dependence upon the frequency and the impurity concentration. It is shown that the density $n_1(\omega)$ in the case $\alpha_2 \ll 1$, $\alpha_1 \sim 1$ possesses two maxima of the same order, one of them lying near ω_g and other near Γ_2. The density $n_2(\omega)$ in the neighborhood of Γ_2 possesses the maximum of higher order than that of $n_1(\omega)$. In the case of the large impurity concentration ($\alpha_1 \gg 1$, $\alpha_2 \sim 1$) the energy gap lies close to the ordering parameter Γ_2, if we assume that $\zeta = \Gamma_1/\Gamma_2 < 1$. Maxima of densities of electron states of both zones $n_n(\omega)$ take place at frequencies close to the parameter Γ_2. (auth)

22514 DYNAMIC INTERMEDIATE STATE IN SUPERCONDUCTORS. Andreev, A. F. (Inst. of Physics Problems, Moscow). Acta Univ. Wratislaviensis; No. 141, 1-15(1970).

An attempt is made to obtain the equations which permit the calculation of the location and velocity of motion of the phase boundaries as functions of time. It is assumed that all quantities (configuration of the phase boundaries, velocity of their motion etc.) change little over distances of the order of the period of the

structure. It is also assumed that the temperature of the system is small compared with the critical temperature of the superconducting transition. First, the macroscopic electrodynamic equations are obtained. Then, a description is introduced which permits the calculation. (MHR)

22515 TIME-DEPENDENT GINZBURG–LANDAU EQUATIONS FOR SUPERCONDUCTING ALLOYS. Weller, W. (Karl-Marx-Universitat, Leipzig). Acta Univ. Wratislaviensis; No. 141, 1-13(1970).

The generalization of the Ginzburg-Landau equation to time-dependent processes is discussed. First, the problem is considered in the framework of the phenomenological nonequilibrium thermodynamics. Since the assumptions made in applying the phenomenological thermodynamics and in introducing the scalar potential do not always hold, a microscopic analysis is done. The special cases of paramagnetic impurities with impurity concentrations close to the critical concentration and of nonmagnetic impurities with high magnetic field are covered. (MHR)

22516 STRUCTURES OF MIXED STATE IN A SUPERCONDUCTOR (OF SECOND TYPE) PLATE OF FINITE THICKNESS. Shekhata, L. N. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 15: No. 1, 99-106(1974). (In Russian).

It is proved that a lattice of wound wire formed in a superconducting (second type) plate of finite thickness almost does not deform. Calculations were carried out on the thermodynamic Gibbs potential, on the maximum and minimum values of the external magnetic field at which the mixed state can still exist with a given value of the induction, on the maximum critical current and the average microscopic field (that is, the induction). (SJR)

22517 THERMOELECTRIC POWER AND NONSTATIONARY JOSEPHSON EFFECT IN S–N–S STRUCTURES. Aronov, A. G.; Gal'perin, Yu. M. (Ioffe Inst. of Physics and Tech., Leningrad). JETP Lett. (USSR) (Engl. Transl.); 19: No. 5, 165-166(5 Mar 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 19: No. 5, 281-283(5 Mar 1974).

It is shown that if a temperature difference is produced on an S–N–S structure, then an ac component of current appears in a circuit containing this structure; its frequency is proportional to the absolute differential thermoelectric power of the normal metal and to the temperature difference on the junction. (auth)

22518 OSCILLATIONS OF THE PHASE OF THE ORDER PARAMETER UPON PROPAGATION OF SOUND IN A SUPERCONDUCTOR. Vardanyan, R. A.; Lisitsyn, S. G. (Inst. of Theoretical Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 19: No. 5, 164-165(5 Mar 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 19: No. 5, 279-281(5 Mar 1974).

It is shown that oscillations of the order-parameter phase set in when longitudinal sound propagates along a thin current-carrying superconducting wire. These oscillations can be observed with the aid of a superconducting magnetometer. (auth)

22519 SPIN RESONANCE AND KNIGHT SHIFT IN SUPERCONDUCTORS. Mints, R. G. (Inst. of High Temperatures, Moscow). JETP Lett. (USSR) (Engl. Transl.); 19: No. 5, 152-153(5 Mar 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 19: No. 5, 253-255(5 Mar 1974).

Spin resonance in bulky superconductors of types I and II, including under conditions when surface superconductivity exists, is considered. The Knight shift in thin superconducting films, which appears when no allowance is made for the spin-orbit interaction, is also considered. (auth)

Equipment and Devices

Refer also to abstracts 20884 and 21874.

22520 (AD-760330) SUPERCONDUCTOR MATERIALS. A Comparison of Selected Strategic Materials Technologies in the U.S. and U.S.S.R. Moran, H. D.; Hanby, K. R. (Battelle Columbus Labs., Ohio (USA). Metals and Ceramics Information Center). Apr 1973. Contract DSA900-73-C-0922. 67p. NTIS $4.50.

The use of superconductive materials in rotating electrical machinery would permit a considerable reduction in equipment size, which would be especially useful for naval applications. All of the known materials for such applications, however, must be maintained at temperatures below 20°K (253°C) in order to keep them in the superconductive state. Materials of construction for equipment used to maintain cryogenic temperatures must be sufficiently ductile at those temperatures to avoid brittle failures in service. Research and development on superconductive machinery, including choice of materials of construction (or development of such materials) is underway in the United States, primarily under sponsorship by ARPA. The objective of the work described in this report was to determine the status of similar work in the USSR. A survey of Soviet research aimed at discovering materials that are superconductive at temperatures above 20°K was included. The method of approach was to survey systematically the recent Soviet literature. (NTIS)

22521 (AGARD-CP-104) ENERGETICS FOR AIRCRAFT AUXILIARY POWER SYSTEMS. Proceedings of the 39th Meeting of the AGARD Propulsion and Energetics Panel, Colorado Springs, Colorado, June 12–15, 1972. Fuhs, A. E. (ed.). (Advisory Group for Aerospace Research and Development, 92 – Neuilly-sur-Seine (France)). Dec 1972. 313p. (In English and French). (CONF-720674-).

Twenty-eight papers are included. Separate abstracts were prepared for fourteen. (MHR)

For abstracts of individual papers see: 20880, 20915, 20916, 22458, and 22522–22531.

22522 (AGARD-CP-104, pp 1.1-1.11) STABILITY OF A SUPERCONDUCTOR AS INFLUENCED BY THE SUBSTRATE. El Bindari, A. (Supertechnology Corp., Boston). Dec 1972.

From 39th meeting of the AGARD propulsion and energetics panel; Colorado Springs, Colorado, USA (12 Jun 1972).

Cladding in superconductive technology has solved many problems, such as reliability in design or utilizing the critical current densities as an almost operating condition. However, it has created new problems which will be mentioned briefly. The overall densities are roughly maintained whether the superconductor is plated or cladded. Thus, the increase in volume by cladding may cause a problem in certain application. The added weight of the substrate makes superconducting magnets prohibitive in some applications. Here some of these problems and how one can find a solution to them are discussed, not only to reduce the amount of the heavy copper substrate but to replace it with a lighter one like aluminum. (MHR)

22523 (AGARD-CP-104, pp 3.1-3.9) BEHAVIOR OF COMPOSITE SUPERCONDUCTING MATERIALS UNDER AC CONDITIONS. Eastham, A. R.; Rhodes, R. G. (Univ. of Warwick, Coventry, Eng.). Dec 1972.

From 39th meeting of the AGARD propulsion and energetics panel; Colorado Springs, Colorado, USA (12 Jun 1972).

AC loss mechanisms in superconductors are described with particular emphasis on the recently developed composite materials. Alternating transport current losses of a wide range of commercially available superconductors of the bare wire and multifilament composite types are presented. The behavior in coil and cable configurations is compared, and it is shown that when self-field effects predominate, little reduction in AC loss results from using multifilament composites as opposed to bare superconducting wire. When transverse field effects predominate, a substantial decrease in loss is possible with composite materials. The effect of transposing the individual filaments within a composite has been investigated, and it is shown that the AC loss can be reduced for a limited range of conditions. Material requirements for low loss conductors are discussed. (auth)

22524 (AGARD-CP-104, pp 5.1-5.8) HIGH FIELD PLASMA ARC-PLATED Nb_3Sn SUPERCONDUCTING SOLENOIDS. Reese, R. A. (Union Carbide Corp., Tarrytown, NY). Dec 1972.

From 39th meeting of the AGARD propulsion and energetics panel; Colorado Springs, Colorado, USA (12 Jun 1972).

Critical current data on plasma sprayed Nb_3Sn conductor for temperatures between 4.2 and 18K and for magnetic fields up to 92kOe are reported. This data and stabilization data are used to study the effect on the mass of an airborne magnet system operating at temperatures above 4.2K, and using aluminum vs. copper stabilized conductor. The use of high conductivity aluminum is shown to substantially reduce the mass of the system. For the system considered, operation at elevated temperature is shown to result in a larger system mass since the increase in magnet mass is much greater than the reduction in refrigerator mass. A comparison is made between refrigeration using a closed cycle refrigerator and using liquid helium carried on board. (auth)

22525 (AGARD-CP-104, pp 8.1-8.7) PROSPECTS FOR SUPERCONDUCTING GENERATORS IN AIRCRAFT. Hayden, J. T. (Cranfield Inst. of Tech., Bedford, Eng.). Dec 1972.

From 39th meeting of the AGARD propulsion and energetics panel; Colorado Springs, Colorado, USA (12 Jun 1972).

A brief review is given of the characteristics of present conventional alternators and aircraft electrical power systems.

Preliminary considerations in the use of superconducting windings in 400 Hz alternators indicate that it is difficult to argue a case in favor of using superconducting machines for typical systems in use at present. Further, there is probably a minimum size of 400 Hz generator for which it is practical to introduce superconducting windings below which there is no significant reduction in weight. If systems requiring powers of a few megawatts are considered, then the case for superconducting machines is much more promising providing that some cryogen (such as liquid nitrogen or liquid hydrogen) is already in the aircraft and available for cooling intermediate heat shields. Continued development in lightweight airborne helium refrigerators is also needed. (auth)

22526 (AGARD-CP-104, pp 9.1-9.4) APPLICATION OF SUPERCONDUCTIVITY TO HOMOPOLAR MACHINERY USING LIQUID METALS. Chabrerie, J. P.; Fournet, G.; Malifert, A. (Laboratoire de Genie Electrique, Paris). Dec 1972.

From 39th meeting of the AGARD propulsion and energetics panel; Colorado Springs, Colorado, USA (12 Jun 1972).

After a short summary of the concept of a homopolar machine with multiple discs and superconducting field winding, using liquid metals for the armature sliding electrical contacts, the authors describe the possibilities of this kind of machine, used as motors or power supplies. These machines operate with a low voltage and a high armature current, and their main features are an important power-to-weight ratio and a good efficiency. The main results of several studies performed since 1966 by the L.G.E.P. and L.C.I.E. are presented. These studies have led to the development of a 60 kW flooded rotor homopolar motor operating at low speed (600 r/min). After a short description of the model motor and a brief account of the main test results, the paper concludes with the choice of liquid metals, their applications to more powerful machines and the influence of the use of liquid metals on the machine morphology itself. (auth)

22527 (AGARD-CP-104, pp 11.1-11.14) SUPERCONDUCTING GENERATORS. Stekly, Z. J. J.; Woodson, H. H. (Magnetic Corp. of America, Cambridge, MA). Dec 1972.

From 39th meeting of the AGARD propulsion and energetics panel; Colorado Springs, Colorado, USA (12 Jun 1972).

The power generation capability of an electrical machine is directly dependent on the current densities utilized in the armature and field windings. Since Type-II superconductors are capable of supporting current densities orders of magnitude higher than room temperature conductors, their utilization in rotating electrical machinery represents a large step toward the development of more compact, lighter weight power supplies. However, since the armature windings of an alternator are exposed to regularly alternating magnetic fields and the Type-II superconductor exhibits large losses when exposed to such fields, their use has been restricted to the field windings. While the field winding is basically dc in nature, it is exposed to time varying fields during loading transients, faults, or unbalanced loads. The design of the field winding must correctly take into account the electromagnetic, electromechanical, structural, and cryogenic effects. The interaction of these effects leads to design criteria which are discussed. The results of a study of size and weight as a function of power level and frequency are presented. Most airborne applications can make use of open cycle helium systems, so that refrigerators need not necessarily be airborne. The refrigeration requirement is broken down into the various sources of heat load and estimates are made for generators of various power levels. The current state of development of ac machines using superconducting windings will be reviewed and the design philosophy and details of specific experimental generators will be examined. (auth)

22528 (AGARD-CP-104, pp 12.1-12.15) SUPERCONDUCTING ELECTRICAL MACHINERY. Mole, C. J. (Westinghouse Research Labs., Pittsburgh); Parker, J. H. Jr.; Lowry, L. R. Dec 1972.

From 39th meeting of the AGARD propulsion and energetics panel; Colorado Springs, Colorado, USA (12 Jun 1972).

Considerable interest in superconducting electrical machinery is developing throughout the world. This paper reviews the more important types of superconducting machines, the features and problems inherent in such machines, and the more promising applications. Both ac and dc superconducting machines are discussed with particular emphasis on the application of ac machines for aircraft use. Recent and current developments in the field are discussed. (auth)

22529 (AGARD-CP-104, pp 13.1-13.8) ENERGY STORAGE AND RELEASE BY MEANS OF SUPERCONDUCTORS. Genevey, P.; Prost, G.; Sole, J.; Girard, B. (CEA, Saclay, France). Dec 1972. (In French).

From 39th meeting of the AGARD propulsion and energetics panel; Colorado Springs, Colorado, USA (12 Jun 1972).

After a review of the principles of the storage and release of electrical energy by means of superconductors, a more detailed analysis of the charging, trapping, storing, and discharge problems illustrate the different problems presented. Original experimental results are then given. The charge operations were carried out by using a high-yield flux pumping, the discharges being released by means of rapid transition superconductor commutators. The most recent experiments undertaken with the Compagnie Electro-Mecanique were described. Discharges reaching several tens of MW of output power were realized with switching times as short as a μsec, leading to high yields. The Compagnie Electro-Mecanique exploits these techniques under CEA license for the development of superconducting electrical energy sources. Much can be expected from superconductors when they will have been correctly adapted to this new and very promising application of storing and discharging electrical energy. (tr-auth)

22530 (AGARD-CP-104, pp 14.1-14.7) RESEARCH ON CRYOGENICS AND INDUCTIVE ENERGY STORAGE AT THE DFVLR. Carpetis, C. (DFVLR-Inst. fuer Energiewandlung und Elektrische Antriebe, Stuttgart). Dec 1972.

From 39th meeting of the AGARD propulsion and energetics panel; Colorado Springs, Colorado, USA (12 Jun 1972).

At the DFVLR-Research-Center Stuttgart, theoretical and experimental work on the application of cryogenics for energy conversion and storage has been performed in recent years. Part of the theoretical examination was devoted to the use of superconducting coils for energy storage. The objective was to find the optimizing parameters and define the problems which must be solved previous to technical use of inductive energy storage. The results indicate that: a) the geometry of the coils is essential for optimal performance. Especially, the ratio of winding thickness to the coil radius has to be chosen carefully; b) high critical current density rather than high critical field is important for optimal devices; c) the specific superconductor mass can be as los as M/E = 2.5 kg/MWs in the region of 10^9 Ws of stored energy. This mass is small compared to the needed structural mass. Experimental investigations are related to the solution of technological problems of cryogenically cooled devices, particularly in presence of time varying fields. An application of high mass-flow cryopumping for experimental purposes is also reported. (auth)

22531 (AGARD-CP-104, pp 15.1-15.6) NONRADIATING SUPERCONDUCTING COILS FOR ENERGY STORAGE. Gayte, M.; Girard, B.; Malandain, A. (Compagnie Electro-Mecanique, Le Bourget, France). Dec 1972.

From 39th meeting of the AGARD propulsion and energetics panel; Colorado Springs, Colorado, USA (12 Jun 1972).

The characteristics of superconducting coils as energy storage elements are investigated together with the main problems affecting their design: electromagnetic forces, energy radiation and discharge losses. An ellipsoid coil set into a shielding coil is then described: its outer field is zero and its shape suitable to withstand the electromagnetic forces. The relation stored energy/superconductor volume is particularly high. An experimental coil located in a stainless steel cryostat was built allowing for the control of the calculation method and the study of the effect of the differences between the real and the theoretical shapes. (auth)

22532 (JINR-P8-7663) SELECTION OF ELECTROINSULATING MATERIALS FOR CRYOGENIC AND SUPERCONDUCTING DEVICES AND STUDY OF THEIR PHYSICAL PROPERTIES. Anishchenko, N. G.; Yavorskii, E. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1974. 24p. (In Russian). Dep. NTIS (US Sales Only) $4.25.

A number of papers are devoted to investigations of electroinsulating materials operating under cryogenic conditions. However, in technical publications there is no common approach to the selection of electroinsulating materials for superconducting devices, and the obtained results are different to a great extent. Here the methods of research used in the division of physical investigations of VUKI (Bratislava, Czechoslovakia) and cryogenic division of JINR (Dubna, USSR) are proposed. The proposed consistency of testing dielectrics in cryogenic conditions, on their molecular level as well, allows not only the selection but also the development of new electroinsulating materials for cryogenic technique. Short static tests make it possible to obtain fast enough the information about the mechanical properties of materials under cryogenic conditions. These tests are the following: (1) heat stroke by liquid nitrogen; (2) determination of frost-resistant and glass temperatures; (3) determination of the so-called thermomechanical graphs; (4) determination of static mechanical properties, and (5) determination of the coefficient of thermal linear expansion.

Some results of these investigations are presented. In particular, it is noted that the problem of the superposition of polymers and metals under cryogenic conditions arises and the knowledge about thermal expansions are extremely important for the epoxy compounds used for impregnating the winding of superconducting solenoids. The dynamic mechanical properties of the materials under cryogenic conditions are determined when measuring the dynamic elasticity modulus or dynamic percussion properties. Electrical investigations of the materials under cryogenic conditions conclude the determination of their short- and long-term electrical strength, ρ_v, ϵ, and tgδ. The dielectrics selected according to the experimental results are subjected to thermal ageing, and then their specific heat and thermal conductivity are determined. The authors recommend to apply some dielectrics as electric insulation of superconducting devices. (auth)

22533 (LA-5631-MS) METHODS OF ENERGY TRANSFER FROM A MAGNETIC ENERGY STORAGE SYSTEM USING A TRANSFER CAPACITOR AND A SUPERCONDUCTING SWITCH. Weldon, D. M.; Lindsay, J. D. G. (Los Alamos Scientific Lab., N. Mex. (USA)). May 1974. Contract W-7405-eng-36. 19p. Dep. NTIS $4.00.

Three circuits for magnetic energy storage using a transfer capacitor and a superconducting switch are analyzed, and a set of equations are derived which can be used for parameter studies of these circuits. (auth)

22534 (LBL-1844) LOW TEMPERATURE STUDIES. I. New Antiferromagnetic Resonance Effects in the Iron-Group Fluorides. II. Impedance Matching a Josephson-Effect Galvanometer by Means of a Superconducting Transformer. Tennant, W. E. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). May 1974. Contract W-7405-eng-48. 119p. Dep. NTIS $9.00.

Thesis.

Far-infrared spectroscopy has revealed several new antiferromagnetic resonance effects in the iron group fluorides. In MnF_2 powders two previously unobserved magnetic absorptions have been seen at 7.7 cm^{-1} and 8.3 cm^{-1} just below the antiferromagnetic resonance at 8.7 cm^{-1}. The 8.3 cm^{-1} mode intensity increases as surface area increases, and may be tentatively identified as a surface magnon. The resonance intensity of this mode is 200 times stronger than a simple theoretical calculation for a surface magnon predicts. Alloy systems of $(Co,Mn)F_2$, $(Fe,Mn)F_2$, and $(Zn,Mn)F_2$ have been studied throughout the concentration range. The magnetic-magnetic systems show two antiferromagnetic resonances, one associated with each magnetic ion. In CoF_2 with a small amount of Mn these modes are found at 28.5 cm^{-1} and 37 cm^{-1}, and in FeF_2 : Mn at 50 cm^{-1} and 53 cm^{-1}. Two additional resonances have been observed in CoF_2 doped with 0.% – 10% Mn. These resonances (at 32 cm^{-1} and 35.5 cm^{-1}) are attributed to interactions between neighboring pairs and triplets of Mn ions in the CoF_2 host lattice. Both the $(Co,Mn)F_2$ and $(Zn,Mn)F_2$ AFMR results show good agreement with the coherent potential approximation theory of these systems. A superconducting transformer has been developed which increased the Johnson-noise limited range of a superconducting galvanometer by five orders of magnitude in resistance. A theory has been developed to evaluate the performance of superconducting galvanometer-transformer combinations. The working model transformer was found to perform according to the theory. (auth)

22535 (LBL-2597) JOSEPHSON JUNCTIONS AS MICROWAVE HETERODYNE DETECTORS. Taur, Y. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Apr 1974. Contract W-7405-eng-48. 133p. Dep. NTIS $9.75.

Thesis.

The properties of point contact Josephson junctions operated as 36 GHz heterodyne detectors have been extensively studied. The measured performance is in good agreement with the theory developed for microwave coupling, conversion efficiency, and intrinsic noise based on the resistively shunted junction model. A tunable cavity matching structure was designed to obtain good rf coupling to the point contact. By operating vanadium junctions at 1.4 K, a single side band mixer noise temperature of 54 K (referred to the input) with a conversion gain of 1.35 and a signal bandwidth of the order of 1 GHz was obtained. This is significantly better than existing resistive mixers in this frequency range. Harmonic mixing, mixing in the presence of relaxation oscillation, and self local oscillator mixing with Josephson junctions were tried also, but the results are not as promising as fundamental mixing with an external local oscillator. Finally, two additional topics are discussed: a Josephson effect homodyne detector, and a proposed design for superconducting bolometers making use of the recently developed superconducting quantum interference devices. (auth)

22536 INVESTIGATION OF HOMOGENEITY OF THE PROPERTIES THROUGH CROSS SECTIONS OF SUPERCONDUCTING WIRES. Goncharov, I. N.; Pashkov, P. P.; Potapov, N. N.; Titov, V. S.; Fridman, A. A.; Khukhareva, I. S. pp 78-82 of Splavy Redkikh Metallov s Osobymi Fizicheskimi Svoistvami. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

In some cases it is necessary to control or know the homogeneity of the properties of thin superconducting wires in the radial direction (for example, during study of the dependence of the critical current density or magnetization intensity on the diameter). The results of measurements across wires with a diameter of 0.29 mm of the microhardness, thermo emf, and distribution of the composition were reported. Data were also given on the electron microscopic and x-radiographic study of the wires. A comparison was made with the results of measurements of the superconducting properties of the central and peripheral regions of the same wire. (tr-auth)

22537 SUPERCONDUCTING MAGNET SYSTEMS. Brechna, H. New York; Springer-Verlag New York, Inc. (1973). 600p. $65.60.

The methods of magnetic field generation are examined, giving attention to high magnetic field laboratories, conventional continuous duty magnets with and without iron, pulsed magnets, cryogenic magnets, and superconducting coils. Magnetic field calculations are discussed together with the phenomena and theory of superconductivity and superconducting alternating current magnets. The general properties of cryogenic fluids are considered along with low temperature processes, questions of liquefaction and refrigeration, the handling and storage of cryogenic fluids, and the physical properties of the cryogenic fluids helium, hydrogen, and nitrogen. Economic considerations in the design of water-cooled, cryogenic and superconducting magnets are also explored and some examples of superconducting magnet systems are provided. (IAA)

22538 PROCESS FOR PREPARING SUPERCONDUCTING NIOBIUM–GALLIUM ALLOY. Vieland, L. J.; Wicklund, A. W. (to RCA Corp.). US Patent 3,824,032. 16 Jul 1974. Filed date 3 Jul 1972. 6p.

An improved method for preparing superconducting niobium–gallium alloy having a high critical temperature is described whereby niobium–gallium alloy is deposited from its halides at temperatures of 640 to 700°C onto a substrate coated with a first layer of a β-tungsten niobium–gallium alloy deposited at temperatures above 700°C. (auth)

22539 JOSEPHSON JUNCTIONS FOR APPLICATIONS. Wilk, T.; Stubb, T. (Helsinki Univ. of Technology, Otaniemi, Finland). J. Jap. Soc. Appl. Phys., Suppl.; 43: 461-463(1974).

From 5th international conference on solid state devices; Tokyo, Japan (29 Aug 1973). See CONF-730861-.

A method of fabricating superconductive tunnel junctions is described. The junctions consist of a vacuum evaporated niobium film, a barrier made by oxidizing the niobium film in a glow discharge and an evaporated lead film. The quality of the junctions depends on the composition of the residual gases in the vacuum system. In proper circumstances junctions are obtained which are stable and reproduceable enough for various applications. (auth)

22540 SUPERCONDUCTORS: A NEW TECHNIQUE FOR THE POWER INDUSTRY. Scurlock, R. G. (Southampton Univ., Eng.). Electron. Power; 20: No. 13, 524-527(11 Jul 1974).

In the heavy electrical engineering industry, there are several ways in which cryogenics can be used to advantage. The advantages offered are cheapness, mechanical convenience, and reduced energy wastage, and deserve wide recognition in today's economic climate. The combination of cryogenics and superconductivity offer a strong contender in the 1970s and 1980s for a place in high-power, heavy electrical engineering. The basic principles of superconductivity are outlined and the problems due to current collapse considered. Some of the areas of application which have strong commercial advantages from the use of zero-resistance, high-current conductors with zero joule heating are: high-power low-speed dc motors, high-power superconducting transmission lines, turboalternators with superconducting field windings. These are discussed. (UK)

22541 POMERANCHUK COOLING BY ADIABATIC SOLIDIFICATION OF HELIUM-3. Betts, D. S. (Sussex Univ., Brighton, Eng.). Contemp. Phys.; 15: No. 3, 227-248(May 1974).

Pomeranchuk argued as early as 1950 that substantial cooling could be achieved by solidifying liquid ^3He since the entropy of the solid at low temperatures is greater than that of the liquid. He expected extremely low temperatures to be accessible, but it now appears that the practical limit is just above 1 mK. Several groups since 1965 have worked with different cell configu-

rations and the Pomeranchuk refrigerator is now established as a research tool. Its development was long delayed by the knowledge that the compressional work must be done in an almost perfectly reversible way. Careful design has shown this to be possible. The chief value has been for experiments in the range 2 mK to 20 mK where it is more powerful than the dilution refrigerator. However, other methods will be necessary below 1 mK. In this paper the thermodynamics of the method are set in the context of other cooling techniques, and a detailed analysis of the principles and practice is given. (auth)

22542 MAGNETOMETRY AT LIQUID HELIUM TEMPERATURES. Swithenby, S. J. (Oxford Univ.). Contemp. Phys.; 15: No. 3, 249-267(May 1974).

The main aim of the article is to survey the present situation in the rapidly expanding field of Superconducting Quantum Interference Device (SQUID) magnetometry. Initially, however, the sensitivity and experimental limitations of conventional (i.e., non-superconducting) instruments are established in a brief survey of some popular low-temperature magnetometers. Subsequently, the origin of the periodic response of both the single and double weak link SQUIDs is explained by simple considerations of the properties of superconducting circuits. The magnitude of the period, 2×10^{-15} Wb, allows the construction of a flux detector of extreme sensitivity. The various geometries of SQUID devices and the ways in which these are incorporated into convenient magnetometer systems are discussed. Some details are given of the attainable noise levels. The many possible uses of SQUIDs are detailed and examples are given of some of the striking measurements which have already been achieved. (auth)

22543 METHOD OF PRODUCING LAMINATED PANCAKE TYPE SUPERCONDUCTIVE MAGNETS. Tanaka, E.; Onodera, Y.; Fukuda, T.; Yamashita, T.; Kuma, S. (to Research Inst. for Iron Steel and Other Metals). US Patent 3,813,764. 4 Jun 1974. Priority date 9 Jun 1969, Japan. 6p.

A superconductive magnet comprises superconductive coiled layers; diffusion shielding coiled layers, between which the superconductive coiled layer is put; stabilizing conductor coiled layers, between which the diffusion shielding coiled layer is put; and a normal conductor acting as a superconductive insulation between the superconductive coiled layers. The superconductive magnet is produced by laminating thin sheets of metal or alloy to constitute the superconductive material in such a ratio that a superconductive alloy or intermetallic compound is formed, superposing thin sheets of metal or alloy shielding diffusion against the former thin sheets and thin sheets of metal or alloy stabilizing the superconductivity on both the surfaces of the laminated sheets respectively, coiling the formed sheets on a core sheath in multilayer, covering the resulting coiled body with an outer sheath, subjecting the assembly to a diameter reducing treatment to adhere the layers and heating the adhered layers until the superconductive alloy or intermetallic compound is formed. (auth)

22544 DUCTILE SUPERCONDUCTING ALLOYS. Tsuei, C. C. (to United States Atomic Energy Commission). US Patent 3,817,746. 18 Jun 1974. Filed date 14 Nov 1972. 12p.

This invention provides an alloy for the commercial production of a ductile superconducting wire wherein superconductivity is produced by the proximity effect or by filament or both. In one embodiment a specific alloy of ductile non-superconductor and superconductor components is provided in a composite consisting of Cu and Nb having discrete randomly distributed Nb particles and/or filaments imbedded in and dispersed in close proximity throughout the composite to form an inhomogeneous system of proximately spaced boundaries between the non-superconducting and the superconducting components for effecting the production of continuous superconducting paths throughout the composite at low temperatures in both the superconductor and non-superconductor components. Other ductile elements for the respective components, comprise Ag, Au, Al, Ga, Ge, V, Sn, Ti or Si, in combination with each other or various alloys and compounds for use in the commercial production of ductile superconductors in accordance with this invention. (auth)

22545 METHOD OF MANUFACTURING A DUCTILE SUPERCONDUCTIVE MATERIAL. Pickus, M. R.; Parker, E. R.; Zackay, V. F. (to United States Atomic Energy Commission). US Patent 3,815,224. 11 Jun 1974. Filed date 8 Jun 1971. 6p.

A ductile superconductive material and method for manufacturing same are described which basically may utilize any porous metal or its hydride with a melting point substantially higher than that of the infiltrating metal that will form a superconductive compound when reacted with the infiltrating metal. The superconductive material is made from a porous strip or tape of niobium or vanadium for example, infiltrated with tin, aluminum, antimony, or gallium, for example, and treated in a manner so as to contain interconnecting filaments of the superconducting phase Nb_3Sn, Nb_3Al, $Nb_3(Al,Ge)$, Nb_3Sb, or V_3Ga, for example. The novel manufacturing process, which is relatively simple and inexpensive provides a method of producing a new and useful end product capable of a broad superconductive range due to the amount of reaction of the infiltrated material with the porous material. The novel process may be utilized in either batch or continuous operational applications. (auth)

22546 MOESSBAUER THERMOMETRY IN THE MILLIKELVIN REGION. Parshin, A. Y.; Peshkov, V. P. (Inst. for Physical Problems, Moscow). J. Low Temp. Phys.; 15: No. 3–4, 417-428(May 1974).

Resonant absorption of γ-rays by ^{57}Fe and ^{119}Sn in iron was investigated to study the possibility of ultralow-temperature measurements by the Moessbauer effect. A dilution refrigerator which could provide temperatures down to 6 mK was used. The Moessbauer temperature of ^{119}Sn coincided with the temperature in the mixing chamber down to 6 mK if the heat input to the absorber was low enough ($\lesssim 10^{-6}$ erg/sec). But the Moessbauer temperatures of ^{57}Fe stayed almost invariable below 15 mK. In the same iron sample the nuclei of ^{57}Fe and ^{119}Sn had different Moessbauer temperatures below 15 mK. The reasons for this phenomenon are not yet clear. (auth)

22547 0.6 T OMNIDIRECTIONAL SUPERCONDUCTING MAGNET SYSTEM. Wagner, D. K. (Cornell Univ., Ithaca, NY). Rev. Sci. Instrum.; 45: No. 5, 621-625(May 1974).

The design and construction of a superconducting magnet system, producing a maximum magnetic field of 0.6 T with any desired direction, is described. The magnet consists of a pair of Helmholtz coils, which can be rotated about a fixed solenoid. The amizuthal angle of the field is selected manually by rotation of the Helmholtz coils, and the polar angle is selected electronically by adjusting the currents in the Helmholtz coils and solenoid appropriately. The latter is accomplished automatically by means of the associated power supply, which is described in detail. The accuracy of the magnet system is approximately 0.8 mT or ½% of the field magnitude, whichever is greater. This system has proved to be indispensable for studies of the rf size effect in pure metals at low temperatures. (auth)

22548 CRYOGENIC INSTRUMENTATION AT AND ABOVE LIQUID HYDROGEN TEMPERATURE: PRESENT AND FUTURE. Keller, W. E. (Los Alamos Scientific Lab., NM). LA-DC-72-855. Advan. Cryog. Eng.; 18: 289-300([nd]).

The instrumentation problems associated with present and possible future large-scale cryogenic systems operating at or above liquid hydrogen temperatures, i.e., at greater than 13.8°K are explored. Some important kinds of cryogenic systems germane to various energy problems are considered briefly. An attempt is made to indicate what kinds of processes and information might be required in order to operate and regulate these systems. Finally the types of instrumentation now available as well as those which will be required to meet the above operational demands are suggested. (MHR)

22549 SUPERCONDUCTOR TRANSMISSION SCHEMES. Smid, J. (Vyzkumny Ustav Energeticky, Prague). Energetika; 24: No. 5, 196-200(May 1974). (In Czech).

A review of requirements placed on future transmission of electric power, properties of superconductors, the present developmental stage of superconductor cables, and the outlook for electric power storage is presented. A project for a superconductor transmission scheme for handling 50 GW of power and storing 5.83 GW-hrs of energy is described. Then the specific properties and the advantages of the system are analyzed. (auth)

PHYSICS (NUCLEAR)

22550 (LBL-2366) NUCLEAR CHEMISTRY. Annual Report. 1973. Hendrie, D. L.; Tsang, C. F.; Zalkin, A. (Eds.). (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). May 1974. Contract W-7405-eng-48. 521p. Dep. NTIS $13.60.

This Annual Report provides descriptions of significant research carried on in the Nuclear Chemistry Division of the Lawrence Berkeley Laboratory during the calendar year 1973. These brief accounts give an overview of this research and its interpretation; more complete descriptions are published in the relevant journals of scientific literature. The scope of the work of the Nuclear Chemistry Division includes low-energy nuclear physics (including nuclear reactions, nuclear structure physics, nuclear fission, and nuclear theory); the relatively new field of heavy-ion interactions; chemical and atomic physics (including atomic and molecular spectroscopy and hyperfine interactions); physical, inorganic, and analytical chemistry (including the application of x-ray crystallography, photoelectron spectroscopy, atomic and molecular spectroscopy, magnetic susceptibility and magnetic resonance techniques); a program of actinide and lanthanide chemistry (including the preparation and characterization of organometallic compounds); radiation chemistry and radiochemistry; a program aimed toward the synthesis and identification of superheavy elements; archaeological research; the development of special instrumentation of many kinds; and a program of environmental research using the highly developed specialized techniques of the Division, such as neutron and ^{3}He activation analysis, x-ray fluorescence analysis, photoelectron spectroscopy, and other applicable instrumentation. A notable event during 1973 was the effective start-up of the SuperHILAC for regular research. Another new direction is an increasing effort in the general area of energy and environmental research. Thesis abstracts and a 40-page list of 1973 publications are also included. (RWR)

Neutron Interactions with Matter

Refer also to abstracts 21160, 22734, and 22997.

22551 (AECL-4826) DIPOLE RESPONSE COEFFICIENT FOR CYLINDRICAL CHANNELS IN NEUTRON DIFFUSION THEORY. Love, M. D.; Kushneriuk, S. A. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). May 1974. 103p. Dep. NTIS (US Sales Only) $8.25. AECL $2.00.

The influence of a cylindrically symmetric, neutron absorbing and scattering channel on the asymptotic neutron flux in the purely neutron scattering medium that surrounds the channel is derived for the case when, in the absence of the channel, the flux distribution is of a linear form. The consideration is one-velocity. The media are of infinite extent and the neutron sources are infinitely far from the channel. Neutron scattering is isotropic. The exact neutron flux distribution in the medium is a solution of an integral equation. Its asymptotic part is of the same form as the solution of the diffusion differential equation. Thus the knowledge of the exact asymptotic solution effectively provides a boundary condition for the diffusion solution. Such conditions, expressed as "dipole response coefficients", are derived using perturbation methods, variational procedures and continuity relations. Results are obtained first for homogeneous channels that absorb neutrons only. Configurations are then generalized to channels that consist of a purely absorbing inner region surrounded by an air-gap or a weakly neutron absorbing sheath or both. Finally channels are considered in which the inner medium scatters as well as absorbs neutrons. (auth)

22552 (AREAEE-173) A STUDY OF ANGULAR–SPACE–ENERGY DISTRIBUTIONS OF SLOW NEUTRONS IN WATER NEAR PLANE ABSORBER. Hussein, A.; Eid, Y.; Zakharkin, L.; Hamouda, I. (Atomic Energy Establishment, Inshas (Egypt)). 1973. 25p. INIS.

Measurements are made of the neutron spectra directed normally to the cadmium plate ($u = -1$) (including perpendicular leakage spectrum) and parallel to the plate ($u = 0$). The present investigation is a continuation of that one carried out previously dealing with the measurements for the case of the spectra directed normally from the plate ($u = +1$). The space–energy distributions of $u = +1$ are measured at distances of 0, 0.25, 0.5, 1.0, 1.5, 3.0 and 5.0 cm from the plate. The grazing spectra ($u = 0$) are measured at 0.65 and 1.5 cm from the plate surface. Results of the vectorial neutron energy spectra near the plate ($u = 1$ and $u = 0$) showed hardening effects in the proximity of the cadmium surface. Spectra measured at the distances of 0.25, 0.5, 1.0 and 1.5 cm from the plate with the two directions ($u = -1$ and $u = +1$) have been compared with the available multigroup solution of one-dimensional kinetic equation based on the Nelkin model for water. The comparison reveals good agreement of the experimental results with theory, and a rather realistic description of calculating thermalization processes near plane absorber is noticed. These measurements are interpreted in terms of the neutron temperature approximation; this procedure allows a direct estimation of the degree of hardening of the neutron spectrum in the vicinity of the plate. The hardening is found as maximum for the leakage spectrum ($u = -1$ and $Z - 0$) whose temperature is 70° higher than that of the asymptotic one. (INIS)

22553 (BNWL-SA-5016) CONVERGENCE OF THE DISCRETE ORDINATES METHOD FOR THE TRANSPORT EQUATION. Anselone, P. M.; Gibbs, A. G. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1974. 27p. (CONF-740229-1). Dep. NTIS $4.50.

From conference on constructive and computational methods in differential and integral equations; Bloomington, Indiana, USA (Feb 1974).

Convergence theorems have been obtained for certain transport problems involving anisotropic scattering, other geometrics, and time dependence. These contributions are surveyed from an abstract and unifying point of view in order to isolate what is essential to the convergence of the discrete ordinates approximations. In the process, methods of analysis are developed which appear to be applicable to very general transport problems and to other integro-differential equations. The discussion is in terms of a sequence of model problems of increasing complexity. All functions considered are real. For mathematical convenience and physical relevance specified functions are continuous and usually nonnegative. It is remarked that the problems surveyed here involve discrete ordinates approximations only for the angular integrals, and thus do not represent the most general case of discretization, as practiced, say, in many nuclear reactor applications today, where the spatial variable is also discretized. However, the powerful analytical tools developed in applications to angular discrete ordinates approximations also show promise for investigations of the more general case. (MHR)

22554 (FEI-427) TRANSMISSION OF NEUTRONS IN SPHERICAL GEOMETRY. A Survey. Van'kov, A. A.; Tsibulya, A. M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1973. 44p. (In Russian). Dep. NTIS (US Sales Only) $5.25.

Different methods for the calculation of the transmission of fast neutrons through spherical shells are considered. A short survey is given of methods for the measurement of transmission for the purpose of determining nuclear physics constants. Conclusions are drawn on the advisability of conducting some new experiments of similar type. (3 figures, 3 tables) (tr-auth)

22555 (IAE-2300) CALCULATION BY THE MONTE CARLO METHOD OF ENERGY, TIME, AND ANGULAR CHARACTERISTICS OF THE SLOWING OF NEUTRONS IN SOME MATERIALS WITH $A < 10$. Peregudov, V. N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1973. 14p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

The energy spectra and time and angular distributions of neutrons emerging from a moderator were calculated by means of the Monte Carlo method. As a source of fast neutrons there was utilized a uranium target, in which neutrons were generated as a result of photonuclear reactions caused by bremsstrahlung of electrons supplied by an accelerator. Polyethylene, heavy water, and beryllium were used as the moderating materials. (3 figures, 8 tables) (tr-auth)

22556 (INDC(CCP)-41/U) NUCLEAR CONSTANTS, NO. 8, Part 4. Providing Nuclear Data for Fast Reactor Calculations. Table of Contents. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow). Jul 1974. Translated from Russian. 3p. Dep. NTIS (US Sales Only) $4.00.

The contents of four articles dealing with constants for neutron calculations for fast reactors are briefly described. (JWR)

22557 (INDC(SEC)-39/U) INDC CORRESPONDENTS FOR THE EXCHANGE OF NUCLEAR DATA INFORMATION. (International Atomic Energy Agency, Vienna (Austria). Nuclear Data Section). Jun 1974. 48p. Dep. NTIS (US Sales Only) $5.50.

A distribution list for documents originated by or for the International Nuclear Data Committee is presented. (JWR)

22558 (KFKI-74-24) DRYDIFF-2: A CODE FOR THE SOLUTION OF FEW-GROUP DIFFUSION EQUATION IN ONE DIMENSION WITH GENERAL ALBEDO-TYPE BOUNDARY CONDITIONS. Lux, I. (Kozponti Fizikai Kutato Intezet, Budapest (Hungary)). Apr 1974. 20p. Dep. NTIS (US Sales Only) $4.00.

A short description of the DRYDIFF-2 one dimensional diffusion code developed for the ICL 1905 computer of CRIP is given. The code uses the method of finite differences, and is able to take into account arbitrary albedo-type boundary conditions at the boundary of the system. This permits the determination of the effect of the dry lattice in water-level-regulated reactors. Besides the formalism, the report gives a detailed user's manual and two sample problems. (auth)

22559 (LA-4855) EVXS: A CODE TO GENERATE MULTIGROUP CROSS SECTIONS FROM THE LOS ALAMOS MASTER DATA FILE. Asprey, M. W.; Lazarus, R. B.; Seamon, R. E. (Los Alamos Scientific Lab., N. Mex. (USA)). Jun 1974. Contract W-7405-eng-36. 51p. Dep. NTIS $5.45.

EVXS is a program for computing multigroup microscopic neutron cross sections from experimental data. It is a translation into FORTRAN-IV of a MADCAP code written by Roger Lazarus of LASL for the MANIAC computer. The sources of data contained in the library processed by EVXS are varied, but the evaluations come primarily from AWRE, LLL, and LASL. The neutron cross sections, fluxes, and secondary energy and angular distributions are given in the library in tabular form with interpolation schemes such that the integrations over neutron energies may be performed exactly in arriving at the group-averaged cross sections. Higher order components of the multigroup cross-section matrices through L = 8 have been generated using EVXS. The code is written in standard ASA FORTRAN and is designed to be computer independent. In addition to the printed results, the output can, at the user's option, include punched cards or magnetic tape suitable for input to neutronics and burn codes. (auth)

22560 (LA-5563) MEASUREMENTS OF NEUTRON AND GAMMA-RAY SPECTRA FROM IRON AND TUNGSTEN SPHERES BOMBARDED WITH NEUTRONS FROM THE $^{2}H(t,n)^{4}He$ REACTION. Arthur, E. D.; Auchampaugh, G. F.; Drake, D. M. (Los Alamos Scientific Lab., N. Mex. (USA)). Jun 1974. Contract W-7405-eng-36. 20p. Dep. NTIS $4.00.

Gamma-ray and neutron spectra produced by pulsed sources of $^{2}H(t,n)^{4}He$ neutrons in the centers of iron and tungsten spheres have been measured using time-of-flight techniques. Identical experimental arrangements, except for detectors, were used for both neutron and gamma-ray measurements. Results of the measurements are presented in formats that can be compared easily with Monte Carlo calculations. (auth)

22561 (LA-5644-MS) BINX: BCD INTERPRETATION OF NEUTRON X-SECTIONS. Soran, P. D. (Los Alamos Scientific Lab., N. Mex. (USA)). Jun 1974. Contract W-7405-eng-36. 14p. Dep. NTIS $4.00.

The BINX code has been developed to permit translation of data libraries from BCD to binary or vice versa. The code is written in FORTRAN and performs translations on the ISOTXS or BROKOX files of the CCCC interface system. (auth)

22562 (ORNL-TM-3995) MACKLIB: 100-GROUP NEUTRON FLUENCE-TO-KERMA FACTORS AND REACTION CROSS SECTIONS GENERATED BY THE MACK COMPUTER PROGRAM FROM DATA IN ENDF FORMAT. Abdou, M. A.; Roussin, R. W. (Oak Ridge National Lab., Tenn. (USA)). Aug 1974. Contract W-7405-eng-26. 67p. Dep. NTIS $6.50.

The computer code MACK was used to produce averaged neutron reaction cross sections and kerma factors in the 100-group GAM structure. Data are included for materials commonly used in CTR neutronics studies. The basic evaluated cross section data from which the resulting group-averaged values were derived was ENDF/B-III. The weighting spectrum used in the energy averaging accounts for the energy distribution of D-T neutrons. The effect of radioactive decay was included for reaction product nuclei with half-lives less than 50 days. The data library and a suitable retrieval program are available upon request as DLC-29/MACKLIB from the Radiation Shielding Information Center at Oak Ridge National Laboratory. (auth) (1 figure, 2 tables)

22563 (RNF-1-73) DETERMINATION OF THE SLOWING DOWN TIME OF FAST NEUTRONS FROM 14.1 MeV TO 0.18 eV IN LIGHT WATER BY THE METHOD OF PULSED NEUTRON SOURCE. Erdinc, S.; Ozdemir, U.; Ozmutlu, C. (Ankara Nuklear Arastirma Merkezi (Turkey)). Feb 1973. 27p. (In Turkish). INIS.

The most probable slowing down time of fast neutrons from 14.1 MeV to 0.18 eV in light water has been determined by the time-dependent measurements of capture gamma-rays emitted from Cd indicator. A Kaman 1001 A model neutron generator having a yield $\phi = 10^{8}$ n/sec for 14.1-MeV neutrons has been used as a pulsed fast neutron source. As a result the neutron slowing down time 2.50 ∓ 0.25 μsec has been obtained. (auth)

22564 (RT/FI-72-44) UPDATING, USING AND CHECKING MULTIGROUP CROSS SECTION SETS FOR FAST REACTOR CALCULATIONS. Cosimi, M.; Salvatores, M. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1972. 85p. (In Italian). INIS.

The problems involved in the updating, using and checking multigroup cross section libraries for fast reactor calculations are presented. Five multigroup cross section sets (ABBN type) are suggested in a unified format. Some checks based on systems which are representative of the PEC reactor are also presented. (INIS)

22565 (UCRL-50400(Vol.3)(Rev.1)) INTEGRATED SYSTEM FOR PRODUCTION OF NEUTRONICS AND PHOTONICS CALCULATIONAL CONSTANTS. Volume 3, Revision 1. Index of the Experimental Data of Neutron-Induced Interactions. Perkins, S. T.; Cullen, D. E.; Haight, R. C.; Howerton, R. J.; MacGregor, M. H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Mar 1974. Contract W-7405-eng-48. 905p. Dep. NTIS $13.60.

A tabulation is presented of the indexes to the neutron-induced interaction data contained in the Experimental Cross Section Information Library (ECSIL) as of March 1, 1974. The tabulation is arranged in three different ways: isotope (ZA) order, reaction number order, reference number order. (5 tables, 3 indexes) (auth)

22566 (WARD-XS-3045-6) PHYSICS EVALUATIONS AND APPLICATIONS. Quarterly Progress Report for Period Ending April 30, 1974. Paik, N. C.; Davis, W.; Yarbrough, M. B. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). Jun 1974. Contract AT(11-1)-3045. 39p. AT.

Emphasis was on nuclear data evaluation and version II of the cross section processing code SPHINX. Fission product yields and radioactive decay data from the fission product subcommittee of CSEWG were incorporated into the ENDF/B-IV ^{238}U data file. Version I of the SPHINX code, essentially complete, was partially tested. The development of Version II SPHINX with a transport theory option is about 50% complete. The programming and testing of the transport cell homogenization routine is in progress. (1 figure, 5 tables) (RWR)

22567 IMPORTANT PARAMETERS OF NEUTRON MULTIPLICATION MEDIA ACCORDING TO THE BINODAL MODEL. Tai, A. S. (Ecole Polytechnique, Lausanne, Switzerland). Helv. Phys. Acta; 47: 106-113(1974). (In French).

By considering a neutron multiplication medium of two zones as one system composed of two point cores between which exists a coupling (the binodal model), the relations for some important parameters of the system, such as multiplication coefficient, reactivity, effective delayed neutron fraction, and neutron lifetime were established. The expressions giving the time evolution of the system in the presence of pulsed neutron sources were also derived. (auth)

22568 DEFECTON EFFECTS IN THE SCATTERING OF SLOW NEUTRONS. Lubchienko, A. F.; Dzyublik, A. Ya.; Korostyl, A. M. (Inst. for Theoretical Physics, Kiev). Phys. Status Solidi (b); 63: No. 1, K55-K57(1 May 1974).

Broad peaks which correspond to one-phonon excitations were previously observed in the experiment on the scattering of slow neutrons by hydrogen in niobium. The peak width was analyzed as attributable to the Arrhenium diffusion. The solid solution of interstitials of low concentration at T = 0 is considered. (JFP)

22569 DISPERSION LAW IN ANISOTROPIC SCATTERING MEDIA. Hino, T. (Hitachi Ltd., Kawasaki, Japan); Ozawa, Y. J. Nucl. Sci. Technol. (Tokyo); 11: No. 3, 110-111(Mar 1974).

Discrete eigenvalues with respect to time and space are derived using the one-velocity transport equation. The variations in discrete eigenvalues because of the anisotropic effect are discussed. (JWR)

22570 EXPERIMENTAL INVESTIGATION OF THE RESONANCE SELF-SHIELDING AND DOPPLER EFFECT IN URANIUM AND TANTALUM. Byoun, T. Y. Troy, NY; Rensselaer Polytechnic Inst. (1973). 238p. University Microfilms Order No. 73-27,197.

Thesis (Ph. D.).

The neutron average transmission and self-indication ratio measurements have been performed on depleted uranium (99.8% ^{235}U and 0.2% ^{238}U) and tantalum up to 100 keV in order to investigate the temperature dependence of the resonance self-shielding effect. These measurements have been carried out at three sample temperatures (77°K, 295°K, and ~1000°K) and with varying sample thicknesses from ~0.1 to ~1.0 mean free path. Both statistical sampling and analytical methods have been used to interpret the data. These calculations have been done by using the known resonance parameter distribution functions and by fitting the data over the range of neutron energies, sample temperatures, and sample thicknesses used in this experiment. Average resonance parameters for both s-wave and p-wave have obtained in the energy range from 10 to 100 keV. The temperature dependence as well as sample thickness dependence of the data have been extensively studied. The average resonance parameters which best fit the experimental results in the energy range from 10 to 100 keV are in essential agreement with the extrapolation of the resolved resonance region parameters. (Diss. Abstr. Int., B)

22571 WEIGHTED CENTRAL DIFFERENCE EQUATIONS FOR THE NEUTRON TRANSPORT EQUATION. Madsen, N. K. (Univ. of California, Livermore). Nucl. Sci. Eng.; 54: No. 4, 376-386 (Aug 1974).

A family of centered difference methods for approximating the solution of the neutron transport equation in x–y geometry is considered. Positivity of some of the difference methods is shown for sufficiently small mesh spacings. Also, in general, the weighted central difference schemes appear to be less oscillatory than the standard diamond scheme. Numerical results as well as heuristic arguments to support these conclusions are presented. (18 figures, 2 tables) (auth)

22572 GENERALIZED COLLISION PROBABILITIES AND NEUTRON TRANSPORT EIGENVALUE PROBLEMS. Lefvert, T. (Research Inst. of National Defense, Stockholm). Nucl. Sci. Eng.; 54: No. 4, 369-375(Aug 1974).

The eigenvalue problem of the integral neutron transport equation is studied by using generalized first-flight collision probabilities. An exact transformation law for these collision probabilities describes how they change when the total cross section of the medium varies. Applying this transformation law on eigenvalue problems of the integral transport equation leads to several useful results. Thus, an explicit eigenvalue equation for the decay constant is derived, and transformed eigenvalue problems for both the multiplication factor, k, and the decay constant, α, are given in terms of the transport properties of a reference configuration and of scaling parameters for uniform size and/or density changes. Exact scaling laws for k and α at constant mean-free-path transformations result as a special case. Finally, a general, higher-order, nonlinear perturbation theory is given for both the multiplication factor and decay constant eigenvalue problems. (2 figures) (auth)

22573 ASYMPTOTIC SOLUTION IN THE THEORY OF NEUTRON MODERATION. Stewart, C. E.; Burkart, A. R. (North Carolina State Univ., Raleigh). Nucl. Sci. Eng.; 54: No. 4, 455-456(Aug 1974).

An asymptotic solution to the equation that describes the slowing down of neutrons is given. (auth)

22574 RAPID CALCULATIONAL METHOD FOR MULTIGROUP ELASTIC TRANSFER. Becker, M. (Rensselaer Polytechnic Inst., Troy, NY). Nucl. Sci. Eng.; 54: No. 4, 465-467(Aug 1974).

Continuous slowing-down theory is applied to the generation of elastic transfer matrices at the broad group level. When this theory is incorporated into a standard processing code, substantial savings in time are achieved while acceptable accuracy is retained. (2 tables) (auth)

22575 PARTIAL-RANGE ANALYSIS OF THE ONE-SPEED NEUTRON TRANSPORT EQUATION WITH ANISOTROPIC SCATTERING. Attia, E. A.; Harms, A. A. (McMaster Univ., Hamilton, Ont.). Nucl. Sci. Eng.; 54: No. 4, 450–455(Aug 1974).

The one-speed neutron transport equation with anisotropic scattering is investigated by the method of partial-range Legendre-polynomial analysis. It is found that appropriate conditions on the spatial moments can be specified by suitable integral operations of the partial-range polynomials. A numerical test suggests that such an analysis does possess potential merit for calculating some neutron transport parameters to a high degree of accuracy, even in a low-order approximation. (3 figures, 1 table) (auth)

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Refer also to abstracts 22225, 22243, 22265, 22325, 22392, 22406, 22410, 22630, 22682, 22894, and 22944.

22576 (FRNC-TH-479) STRUCTURE OF ^3H AND ^3He NUCLEI USING THE FADDEEV EQUATIONS IN CONFIGURATION SPACE. Laverne, A. (Grenoble-1 Univ., 38 (France)). 1973. 92p. (In French). Dep. NTIS (U. S. Sales Only) $7.75.

Thesis. Submitted to Universite Scientifique et Medicale de Grenoble (France).

The Faddeev equations are considered in configuration space in order to resolve the hard core problem (state related to three particles). A simple method is presented for solving the system of integral differential equations in realistic cases. The programming of the algorithm is presented: inverse iterations and successive overrelaxations in polar coordinates. The method has the following advantages: ease of programming, small calculation times involved, and small amount of computer memory space taken up. The problems treated were always limited to fewer than six Faddeev amplitudes, although this number is not restrictive. A hard potential (soft-core Reid potential), a Gaussian potential, and a very soft potential were used successively. The method is unsuitable for the treatment of hard-core interactions because of the truncation occurring of the Faddeev amplitude expansion. Serious difficulties are also encountered in the treatment of three-nucleon scattering (nonbound states, integration boundaries). The treatment of nonlocal potentials should not pose any particular problems, the spread out nonlocality being introduced by the source terms. (FR)

22577 (IC-73-161) PHOTODISINTEGRATION OF ^3He AND SCHIFF WAVE FUNCTION. Erdas, F.; Pompei, A.; Quarati, P. (International Centre for Theoretical Physics, Trieste (Italy)). Oct 1973. 8p. INIS.

It has been investigated, by means of partial photonuclear sum rules, whether the widely used ^3He wave function which comprises S, S' and D states (Schiff w. f.), given in terms of Gaussian functions, is capable of explaining the experimental equality σ_{-1} (d,p) = σ_{-1} (p,pn).

22578 (INIS-MF-1168-2, pp vp, 26p) ELECTROMAGNETIC INTERACTION IN THREE NUCLEON PROBLEM. Kim, Y. E. (Purdue Univ., West Lafayette, IN). 1973.

From Finnish summer school in nuclear physics; Liperi, Finland (11 June 1973).

The discussion of the electromagnetic interaction in the three nucleon problem covers the classification of states, coupling states for local nucleon–nucleon interactions, Derric–Blatt spin–isospin basis states, trinucleon bound-state wave function, electromagnetic form factors, charge form factors for helium-3, single-particle shell model, magnetic moments, and meson exchange currents. (JFP)

22579 (INIS-MF-1168-2, pp vp, 39p) SELECTED TOPICS IN THE FADDEEV THEORY OF TRINUCLEON BOUND STATES. Tubis, A. (Purdue Univ., West Lafayette, IN). 1973.

From Finnish summer school in nuclear physics; Liperi, Finland (11 June 1973).

Some of the physics and calculational technology associated with the solution of the Faddeev equations for the bound-state properties of realistic trinucleon systems are described. (Realistic trinucleon systems are those in which the two-nucleon potential gives a good fit to two-body bound-state and scattering data for $E_{lab} \cong 350$ MeV and has a local one-pion-exchange tail.) The Faddeev formalism as applied to the trinucleon bound-state problem, models for the off-energy-shell two-nucleon T-matrix (the basic input in the Faddeev equations), and several techniques for solving the homogeneous Faddeev equations for bound states are discussed. (JFP)

22580 (ITF-74-13P) CLUSTER STRUCTURE OF THE BOUND STATE OF THREE-PARTICLE SYSTEM WITH SPACE FUNCTION OF INTERMEDIATE SYMMETRY. Vasilevskii, V. S. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1974. 15p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

Pair clustering of the bound S state of a three-particle system with space function of intermediate symmetry, total spin $S = \frac{1}{2}$ and isospin $T = \frac{1}{2}$ is considered. Cluster structure is investigated as a function of the form and intensity of the two-particle interaction potential as well as of the spin–isospin cluster state. (auth)

22581 (ITF-74-43P) CALCULATION OF CROSS-SECTION OF TWO-PARTICLE ELECTRODISINTEGRATION OF ^{3}He AND ^{3}H NUCLEI, TAKING INTO ACCOUNT THE FINAL-STATE INTERACTION. Tartakovskii, V. K. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1974. 18p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

The high-energy electron scattering on the ^{3}He and ^{3}H nuclei accompanied by two-particle nuclear disintegration is considered. The influence of the final-state interaction on the produced nucleon and scattered electron angular distributions is also studied. The K- harmonic method is applied for describing the three-nucleon system in both initial and final states. The final-state wave functions are calculated in the interpolation approach on the basis of the two-nucleon rectangular potentials used to obtain the initial-state functions. A good agreement with available experimental coincidence data is obtained. (auth)

22582 (ITF-74-44P) INTERPOLATION APPROACH IN CALCULATING ELECTRODISINTEGRATION IN THREE-NUCLEON NUCLEI. Tartakovskii, V. K.; Kozlovskii, I. V.; Fursa, A. D. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1974. 24p. (In Russian). Dep. NTIS (US Sales Only) $4.25.

Within the interpolation approach the wave functions of a three-nucleon system are considered in a continuous energy spectrum when the system represents a deuteron and a nucleon. The calculations are performed using the two-particle nuclear square-well potential for the different relative momenta of the nucleon and deuteron. Using the functions calculated in this way as the final-state functions, the angular electron distributions are obtained under inelastic scattering by the nuclei ^{3}H and ^{3}He accompanied by the two-particle nuclear disintegration. The account of the final state interaction improves the agreement of the calculated cross-sections with the available experimental ones. (auth)

22583 (JINR-E4-7993) COULOMB EFFECTS IN THE ^{3}He $\rightarrow$ d + p VERTEX. Borbely, I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 9p. Dep. NTIS (US Sales Only) $4.00.

Using the singularity subtraction method and taking into account Coulomb effects in the vertex we determined the ^{3}He $\rightarrow$ d + p vertex constant was determined from D(d,n)^{3}He reaction data with a 4% error. New results on the t $\rightarrow$ d + n vertex constant are also presented, and a significant difference between the two constants is found. (auth)

22584 (UCRL-75694) ATLAS OF PHOTONEUTRON CROSS SECTIONS OBTAINED WITH MONOENERGETIC PHOTONS. Second Edition. Berman, B. L. (comp.). (California Univ., Livermore (USA). Lawrence Livermore Lab.). 6 May 1974. 134p. (CONF-740806-1). Dep. NTIS $9.75.

From Gordon conference; Tilton, New Hampshire, USA (Aug 1974).

Photoneutron cross-section data obtained with monoenergetic photons are presented in a uniform format. This compilation is current as of mid-1974. (auth)

22585 (ZfK-262, pp 3-4) EXPERIMENTS ON THE STUDY OF THE CLUSTER STRUCTURE OF LIGHT NUCLEI WITH HIGH-ENERGY PROTONS. Komarov, V. I.; Kosarev, G. E.; Kusmin, E. S.; Molokanov, A. G.; Reshetnikov, G. P.; Savchenko, O. V.; Tesh, Z. (Joint Inst. for Nuclear Research, Dubna, USSR). Sep 1973. (In German).

22586 CALCULATIONS OF MESON EXCHANGE CORRECTIONS TO TRITON BETA DECAY USING STANDARD WAVE FUNCTIONS WITH SHORT-RANGE CORRELATIONS. Guiasu, I. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys.; 19: No. 3, 351-361(1974).

The weak axial exchange current contribution to the S-D nuclear matrix element in the ^{3}H β-decay is computed in the O. P. E. approximation. Short-range correlations of the Jastrow type are included in the S-component of the A = 3 nuclei ground state. The dependence of $\delta^{(2)}$ on the nuclear wave function parameters is tabulated. As is expected the short-range effects on the exchange current matrix element in the O. P. E. are small. (auth)

22587 STATISTICAL THEORY OF ENERGY LEVELS AND RANDOM MATRICES IN PHYSICS. Carmeli, M. (Univ. of Negev, Beer Sheva, Israel). J. Statist. Phys.; 10: No. 4, 259-297(Apr 1974).

The physical aspects of the statistical theory of the energy levels of complex physical systems and their relation to the mathematical theory of random matrices are discussed. After a preliminary introduction we summarize the symmetry properties of physical systems. Different kinds of ensembles are then discussed. This includes the Gaussian, orthogonal, and unitary ensembles. The problem of eigenvalue-eigenvector distributions of the Gaussian ensemble is then discussed, followed by a discussion on the distribution of the widths. The symplectic group and quaternions, and the Gaussian ensemble are discussed in detail. (auth)

22588 NUCLEON-NUCLEON SCATTERING ANALYSES. I. Proton-Proton Scattering, from 1 to 500 MeV. Arndt, R. A.; Hackman, R. H.; Roper, L. D. (Virginia Polytechnic Inst., Blacksburg). Phys. Rev., C; 9: No. 2, 555-568(Feb 1974).

Energy-independent and energy-dependent analyses are given for the proton-proton scattering data from 1 to 500 MeV. These analyses are similar to those of the Livermore series, but a number of modifications have been made, particularly in the low-energy representation. First, the range of the analyses has been extended by 50 MeV (i.e., from 450 to 500 MeV) and provisions have been made to include total cross sections in the analyses. This and new data additions have resulted in a 20% expansion of the data base. The other modifications concern the low-energy data and the representation bases. To help alleviate normalization difficulties with the low-energy data, the normalization errors of all experiments in the 0- to 10-MeV energy range were floated. The S-wave scattering-length and effective-range parameters were adjusted to give the best fit to the data, and the energy-dependent representation was modified to account for low-energy Coulomb effects. A 28-parameter energy-dependent solution is obtained which is quite good, with χ^2 = 1052 for 1233 data. This is a definite improvement over the Livermore result, but the phase shifts in the 50- to 400-MeV range are virtually unchanged (with the exception of the $^3F_4$ and $^1G_4$ phases) despite the modifications to the bases functions, a strong indication that the data place strong restrictions on the phases. (auth)

22589 NEW VARIATIONAL METHOD AND BINDING ENERGY OF THE TRITON WITH REALISTIC POTENTIALS. Akaishi, Y. (Hokkaido Univ., Sapporo); Sakai, M.; Tanaka, H.; Hiura, J. Progr. Theor. Phys. (Kyoto); 51: No. 1, 134-154(Jan 1974).

A new variational method is proposed on the basis of multiple scattering theory. The new method settles the difficulty in constructing a trial wave function in the presence of the repulsive core and the strong tensor force of realistic potentials. The D-state function has a form much different from Jastrow's. Derrick and Blatt's expansion of the wave function is made. The Hamada-Johnston (H-J) and the Tamagaki (OPEH and OPEG) potentials are employed. The upper-bound energies for the triton are found to be -6.0 MeV for H-J, -6.59 MeV for OPEH and -6.64 MeV for OPEG. Detailed contributions to the interaction energy are calculated. The tensor force in the triplet-even state has the largest contribution and, in the case of H-J, nonstatic forces have a contribution of about -3 MeV. The new method is powerful in solving the three-nucleon problem with realistic potentials. (auth)

22590 VARIATIONAL CALCULATIONS OF THE ALPHA PARTICLE WITH REALISTIC NUCLEON-NUCLEON POTENTIALS. Sakai, M. (Hokkaido Univ., Sapporo); Akaishi, Y.; Tanaka, H.; Shimodaya, I.; Hiura, J. Progr. Theor. Phys. (Kyoto); 51: No. 1, 155-172(Jan 1974).

A new variational method is applied to the alpha particle. Variational parameters required are only a few. The realistic potentials used are the Hamada-Johnston (H-J) and the Tamagaki (OPEH and OPEG) potentials. Numerical integrations are carried out using the quasi-random number method and the Monte Carlo method. The upper-bound energies obtained are -19.0 MeV for H-J, -22.1 MeV for OPEH and -20.5 MeV for OPEG. The tensor force in the triplet-even state has large contribution to the energy. This comes from the characteristic of the new method in which the D-state function is not of Jastrow's type but a multiple scattering one. (auth)

22591 SPIN AND QUASIFREE PROTON-PROTON SCATTERING ON ^{3}He AND ^{4}He. Haracz, R. D.; Lim, T. K. (Drexel Univ., Philadelphia). Phys. Rev., C; 9: No. 2, 569-575(Feb 1974).

Theoretical expressions for the differential cross section of symmetric, coplanar (p, 2p) quasifree scattering on ^{3}He and ^{4}He are derived in the plane-wave impulse approximation with full account given to the spin effects of the nucleon-nucleon interaction and the nuclear bound states. The phenomenological M_{12} matrix is utilized as are correlated functions and Eckart parametrizations of the distribution functions for the light nuclei. Shape fits to experimental data for the Eckart parametrizations are found to be extremely good although theory overpredicts the magnitudes of the cross sections. It is shown that an intuitive extension of the attenuation model of Rogers and Saylor is able to remove this latter discrepancy in ^{3}He(p, 2p)^{2}H. The possible

usefulness of the matrix elements in polarization studies is indicated. (auth)

22592 ENERGY MOMENTS OF THE TOTAL γ-QUANTA ABSORPTION CROSS SECTION FOR ^{4}He NUCLEUS. Arkatov, Yu. M.; Vatset, P. I.; Voloshchuk, V. I.; Zolenko, V. A.; Prokhorets, I. M.; Chmil, V. I. (Physical-Technical Inst. Kharkov). Yadern. Fiz.; 19: No. 6, 1172-1176(Jun 1974). (In Russian).

Energy moments of the total γ-quanta absorption cross section for the ^{4}He nucleus are determined. Mean energies of the dipole and quadrupole transitions, the contribution from the E2 transitions to the total cross sections, the r.m.s. radius of the ^{4}He nucleus are calculated, using the sum rule method. A conclusion is deduced that the contribution from the quadrupole absorptions to the total cross section of the reaction ^{4}He(γ,pn)^{2}H may be as much as 50%. (auth)

22593 ELASTIC AND INELASTIC 180 DEGREE ELECTRON SCATTERING FROM HYDROGEN, DEUTERIUM, AND HELIUM-3. Jones, E. C. Jr. Washington, DC; American University (1973). 122p. University Microfilms Order No. 74-14,247.

Thesis (Ph. D.).

A beam of 56.4-MeV electrons was scattered at 180 degrees from hydrogen, deuterium, and helium-3. The elastic and inelastic spectrum of each nucleus was measured. The hydrogen elastic cross section was used to calibrate the experimental apparatus by comparing the experimental hydrogen cross section to standard values of hydrogen cross sections. With this calibration the experimentally determined magnetic radii of ^{2}H and ^{3}He are 1.47 ± 0.09 and 1.55 ± 0.14, respectively. The electrodisintegration cross section of ^{2}H is compared with theoretical electrodisintegration calculations. Theory compares favorably with experiment at the electrodisintegration threshold. As excitation energy increases, theory becomes less than experiment; at 16 MeV excitation energy, theory is about 50 percent below experiment. The ^{3}He electrodisintegration cross section is quite small and difficult to separate from background. The ^{3}He theoretical electrodisintegration cross section has yet to be calculated. The sum rule compares very favorably to experiment for both ^{2}H and ^{3}He. This close agreement indicates that there are no large contributions from anomalous electromagnetic currents, such as two- and three-body meson exchange currents. (Diss. Abstr. Int., B)

22594 PROTON DIFFRACTION DISSOCIATION AND ELASTIC SCATTERING FROM ^{4}He. Ekeloef, T. (CERN, Geneva); Herz, A. J.; Hagberg, E.; Kullander, S.; Bruton, P. C.; Curran, C. S.; Davies, J. K.; Fisher, S. M.; Heymann, F. F.; Imrie, D. C. pp 136-139 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973). See CONF-730642-.

Preliminary results are presented of an experiment to study the coherent interaction of high-energy protons with ^{4}He. The elastic angular distribution is in good agreement with Glauber model calculations at four-momentum transfers below 0.2 (GeV/c)^2. At larger values of the four-momentum transfer there is evidence for the expected single-double scattering interference minimum and for a secondary maximum due to double scattering, but the data are too preliminary to permit detailed comparisons with current models at the present time. The effective-mass distribution of the pππ system for a restricted class of p — pππ events, in which the momenta of all three fast secondaries are measured, has the expected peaks at 1.5 and 1.7 GeV/c^2. There is also an indication of structure at a mass close to 2.0 GeV/c^2. (auth)

22595 p-^{4}He COHERENT SCATTERING AT 24 GeV/c. Observation of the Elastic Scattering and Production Processes by a Missing Mass Method. Berthot, J. (Clermont-Ferrand Univ., France); Gardes, J.; Meritet, A.; Pauty, J. F.; Peynet, G.; Querrou, M.; Vazeille, F.; Burq, J. P.; Chemarin, J.; Ille, B. pp 140-142 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973). See CONF-730642-.

The coherent scattering of protons on helium 4 is observed at 24 GeV/c using a missing mass method, i.e., detecting the recoil nucleus and measuring with a high accuracy its identification parameters, angle and energy. The angular spectrum of ^{4}He for each energy channel in single and double scattering t region exhibits some peaks due to baryon resonances (N^*_A) at rest mass of 1500 and 1700 MeV. (auth)

22596 COHERENT PHOTOPRODUCTION OF π^+ ON ^{3}He. Bachelier, D.; Bernas, M.; Boyard, J. L.; Jourdain, J. C.; Lazard, C.; Maric, Z.; Radvanyi, P. (Inst. of Nuclear Physics, Orsay, France). pp 151-153 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973). See CONF-730642-.

A shift towards lower energies of the 3—3 resonance has been observed in the coherent π^+ photoproduction on ^{3}He; no minimum appears around 11.6 fm^{-2} in the measured cross-section versus q^2. Theoretical explanations are proposed for these two effects. (auth)

22597 $\pi^\pm$ ^{4}He ELASTIC SCATTERING AND ELECTROMAGNETIC PION RADIUS. Nichitiu, F. (Joint Inst. for Nuclear Research, Dubna, USSR). pp 178-183 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973). See CONF-730642-.

Hofstadter and Sternheim originally proposed to obtain the electromagnetic pion radius from the analysis of elastic scattering $\pi^\pm$ on ^{4}He. Up to now, some experiments and analyses have been made of the $\pi^\pm$ ^{4}He elastic scattering which parametrized the nuclear amplitude in different ways (via the optical model like the Kisslinger model or simple with phase shifts) from which pion radius still remains much larger than 2.0 fm. On the other hand, it was shown that the phase shift analysis for $\pi^\pm$ ^{4}He elastic scattering (energy range 24 ... 153 MeV) gives only two solutions and of these two the first one seems to be "physical solution." The ambiguity in nuclear amplitude, the total cross-section and the incident beam energy are very important and have much larger effects on the electromagnetic pion radius calculations than all other Coulomb corrections. The average value of the electromagnetic pion radius calculated with solution I for the phase shifts and taking into account the non-point Coulomb phase shifts is $\langle r^2 \rangle^{\frac{1}{2}}$ = 0.80 ± 0.40 fm for the Crowe experiment (the error contains the uncertainty in the $X = \sigma_{el}/\sigma_{tot}$ ratio and therefore in the total cross-section). (auth)

22598 MOMENTUM COMPONENTS OF THE DEUTERON: 200 TO 400 MeV/c. Igo, G. J.; Nasser, M. (Univ. of California, Los Angeles). pp 200-204 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973). See CONF-730642-.

Large angle, elastic proton—deuteron scattering is analyzed with the Kerman—Kisslinger pick-up model including second order (distorted wave) corrections. (auth)

22599 RADIATIVE PION CAPTURE IN LIGHT NUCLEI. Truoel, P. (Univ., Zurich); Baer, H. W.; Bistirlich, J. A.; Crowe, K. M.; de Botton, N. pp 247-253 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973). See CONF-730642-.

New results from a high-resolution measurement of the photon spectra following radiative pion capture in ^{3}He, ^{6}Li and ^{14}N are presented. The observed branching ratios to bound states are compared with theoretical calculations based on the impulse approximation. For the 1p-shell nuclei excellent agreement is obtained, when shell model wavefunctions and a Hamiltonian deduced from the fundamental process $\pi^-p \to n\gamma$ are used. For the ^{6}Li-(π^-,γ)^{6}He(0^+) and the ^{3}He(π^-,γ)^{3}H transitions predictions are tested using PCAC and soft-pion techniques, which are especially relevant in comparison to the experimentally observed Panofsky-ratio in ^{3}He. Transitions to higher excited states in the giant resonance region and into the continuum are also discussed. (auth)

22600 REACTION d(p,π^+)t. Perdrisat, C. F.; Dollhopf, W.; Lunke, C.; Roberts, W. K.; Kitching, P.; Olsen, W. C.; Priest, J. R. (College of William and Mary, Williamsburg, VA). pp 285-288 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973). See CONF-730642-.

The differential cross section for the reaction d(p,π^+)t has been measured for CM angles between 37 and 160°, at incident proton

energies of 470 and 590 MeV. The results are in qualitative agreement with prediction of a model of the reaction assuming that it is a two-nucleon process, but for the existence of a backward peak at 470 MeV. No satisfactory explanation of this backward peak is forthcoming, although it is noted that a similar peak exists in previously published data. (auth)

22601 SOME ANOMALIES IN THE MULTIPLE PRODUCTION OF PIONS WITH LIGHT NUCLEI. The ABC and DEF Effects. Le Brun, C. (CEN de Saclay, Gif-sur-Yvette, France). pp 315-320 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973). See CONF-730642-.

The ABC effect has been studied in the missing mass spectra of the reactions $n + p \rightarrow d + mm^0$, $d + p \rightarrow {}^3He + mm^0$ and $d + d \rightarrow {}^4He + mm^0$ and the DEF effect (460 MeV) has been found in the second reaction. Some new interpretations are presented. (auth)

22602 MOMENTUM DISTRIBUTIONS OF NEUTRONS IN ^2H, ^3H, AND ^4H FROM QUASI-ELASTIC SCATTERING OF 1.3 GeV/c PROTONS. Kirby, P.; Daniels, J. M.; Gajdicar, T.; Friedlander, S.; Krebs, G. F.; Coombes, H.; Dennig, E. L; Kairies, K. (Univ. of California, Berkeley). pp 383-386 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973). See CONF-730642-.

Measurements are reported of quasi-elastic scattering of 1.3 GeV/c protons off neutrons in the three light nuclei ^2H, ^3He and ^4He. Momentum distributions of neutrons in these nuclei are determined along 3 mutually perpendicular axes and gaussian distributions fitted to each of the three components. Comparison is made to other work on momentum distributions of protons in these nuclei. (auth)

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Refer also to abstracts 21965, 22243, 22275, 22584, 22599, 22682, 22701, 22720, 22729, 22749, and 22897.

22603 (CERN-74-8, pp 63-91) RADIATIVE PION CAPTURE. Truoel, P. (Univ., Zurich). 10 Apr 1974.

From intermediate energy physics meeting; Zuoz, Switzerland (13 Apr 1973).

It is argued that in radiative pion capture is a theoretically rather well treated experimentally accessible tool which provides a new type of nuclear structure information. The reason for this is that this process is an electromagnetic process and occurs contrary to most of the other pion absorption modes on a single nucleon in the nucleus. Lithium-61 is considered. (JFP)

22604 (CONF-731146-2) PERSISTENCE OF THE $^{12}C + {}^{16}O \rightarrow {}^{28}Si$ RESONANCE IN THE REACTION $^{13}C(^{16}O, {}^{17}O)^{12}C$. Debevec, P. T. (Argonne National Lab., Ill. (USA)). 1974. 34p. Dep. NTIS $4.75.

From meeting of the American Physical Society; Bloomington, New York, USA (3 Nov 1973).

Data showing a ^{28}Si resonance in the $^{13}C + {}^{16}O \rightarrow {}^{17}O + {}^{12}C$ reaction are described. Experiments on $^{15}N + {}^{12}C \rightarrow {}^{16}O + {}^{11}B$ which appear to be understandable solely by a direct reaction model are also discussed. Finally, some other data on $^{13}C + {}^{16}O \rightarrow {}^{12}C + {}^{17}O$ which suggest a dominant direct-reaction mechanism are examined. (JWR)

22605 (COO-2167-3) CYCLOTRON LABORATORY ANNUAL REPORT, JUNE 15, 1973-JUNE 15, 1974. (Michigan Univ., Ann Arbor (USA). Dept of Physics). 1974. Contract AT(11-1)-2167. 117p. Dep. NTIS $9.00.

A summary of the research and technical development carried on in the Cyclotron Laboratory of the Department of Physics at The University of Michigan during the period June 15, 1973 to June 15, 1974 is given. The bulk of the experimental effort was devoted to experiments utilizing the neutron time-of-flight system, to a continuation of the investigations of rare earth nuclei using single-proton transfer reactions, and to studies of a number of light nuclei. The major technical effort was devoted to the construction and initial operation of the total instrumentation necessary for the study of heavy-ion-induced reactions. This instrumentation includes a new ion source designed to produce beams of heavy ions and a new focal plane detection system based upon a position-sensitive proportional counter. Eight of the papers in this report are separately title listed. (RWR)

For title listings of individual papers see: 22606-22609, 22731, 22771, 22772, and 22810.

22606 (COO-2167-3, pp 3-5) (d,^{6}Li) REACTIONS ON LIGHT AND HEAVY NUCLEI. VanderMolen, A.; Becchetti, F. D.; Janecke, J. 1974.

In Cyclotron Laboratory annual report, June 15, 1973-June 15, 1974.

22607 (COO-2167-3, pp 9; 10) REACTION $^{18}O(\alpha, {}^3He)^{18}O$. Milder, F. L.; VanderMolen, A.; Becchetti, F. D.; Janecke, J.; Chua, L. 1974.

In Cyclotron Laboratory annual report, June 15, 1973-June 15, 1974.

22608 (COO-2167-3, pp 9; 11-14) $^{18,16}O(^4He, {}^6He)^{16,14}O$ REACTIONS. VanderMolen, A.; Janecke, J.; Becchetti, F. B.; Chua, L. 1974.

In Cyclotron Laboratory annual report, June 15, 1973-June 15, 1974.

22609 (COO-2167-3, pp 14-25) REACTION $^{16}O(d, {}^3He)^{15}N$ AT 29.0 MeV. Firestone, M. A.; Janecke, J. 1974.

In Cyclotron Laboratory annual report, June 15, 1973-June 15, 1974.

22610 (COO-3496-44, pp 147-166) EFFECT OF PRESSURE ON RADIOACTIVE DECAY CONSTANTS. 1974.

In studies of nuclear fission, low-energy nuclear reactions and transuranic nuclei.

22611 (DESY-74/18) QUASI-ELASTIC ELECTRON SCATTERING (e,e'p) AND (e,e'd) FROM ^{6}Li IN A COINCIDENCE EXPERIMENT. Heimlich, F. H.; Roessle, E.; Koebberling, M.; Moritz, J.; Schmidt, K. H.; Wegener, D.; Zeller, D.; Bienlein, J. K.; Bleckwenn, J.; Dinter, H. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). May 1974. 32p. Dep. NTIS (U. S. Sales Only) $4.75.

Coincidence cross sections for the reactions ^{6}Li (e,e'p) and ^{6}Li(e,e'd) were measured in the region of quasi-elastic scattering. With incident electrons of 2.5 and 2.7 GeV, the four-momentum transfers to the proton were 6.6 fm^{-2}, 10.0 fm^{-2} and 11.6 fm^{-2}. The proton coincidence data agree with shell-model distributions assuming a Woods-Saxon potential and including short-range nucleon-nucleon correlations. The best fit to the deuteron coincidence data is obtained with a cluster wave function for the p nucleons and a harmonic oscillator wave function for the s nucleons, the deuteron yield from the s shell being taken into account. The ratio of the deuteron cross section from ^{6}Li divided by the elastic e-d scattering cross section depends only slightly on the four-momentum transfer and has a value of ~2. (6 figures, 2 tables) (auth)

22612 (DESY-74/20) HIGH ENERGY ELECTRON SCATTERING FROM ^{6}Li AND ^{12}C. Heimlich, F. H.; Koebberling, M.; Moritz, J.; Schmidt, K. H.; Wegener, D.; Zeller, D.; Bienlein, J. K.; Bleckwenn, J.; Dinter, H. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F.R. Germany)). May 1974. 30p. Dep. NTIS (US Sales Only) $4.50.

The spectra of electrons scattered from ^{6}Li and ^{12}C were measured for invariant masses of the hadronic system W ≤ 1.5 GeV and four momentum transfers in the range 5 fm^{-2} ≤ q^2 ≤ 12 fm^{-2}. The shape of the spectra were compared with different nuclear models. The fermi-gas model of the nucleus cannot reproduce the data. A shell model with short-range correlations fits the data with a correlation parameter $q_c \approx 250$ MeV/c. From the absolute cross section the effective number of nucleons was derived for quasi-elastic scattering and found to be compatible with A, whereas the effective number of nucleons derived for the excitation of the Δ(1236)-resonance was to 0.6 A. (auth)

22613 (DESY-74/22) MOMENTUM DISTRIBUTION OF BOUND STATE PROTONS DERIVED FROM QUASI-FREE ELECTRON SCATTERING ON ^{12}C. Koebberling, M.; Moritz, J.; Schmidt, K. H.; Wegener, D.; Zeller, D.; Bienlein, J. K.; Bleckwenn, J.; Dinter, H.; Heimlich, F. H. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F.R. Germany)). May 1974. 13p. Dep. NTIS (US Sales Only) $4.00.

Quasi-elastic electron scattering from ^{12}C in the range of the four-momentum transfer 5 fm^{-2} ≤ q^2 ≤ 11 fm^{-2} was measured. The momentum distribution of the bound-state protons derived from this experiment shows a large tail of high momenta. Nuclear wave functions including short-range nucleon-nucleon correla-

tions with a parameter q_c = 300 MeV/c give a better fit to the data than pure shell-model wave functions. (2 figures, 1 table) (auth)

22614 (INIS-MF-1168-2, pp vp, 28p) THREE-BODY MODEL CALCULATIONS FOR THE DEUTERON–NUCLEUS COLLISION. Bencze, G. (Univ. of Helsinki). 1973.

From Finnish summer school in nuclear physics; Liperi, Finland (11 Jun 1973).

Some preliminary results of a three-body model study of the ^{16}O + d collision are reported in which some realistic features are included. In particular, the role of realistic bound state form factors and the effect of spectroscopic factors were studied. (JFP)

22615 (INIS-mf-1168/2, pp vp 28p) THREE-BODY MODEL CALCULATIONS FOR THE DEUTERON–NUCLEUS COLLISION. Bencze, G. (Helsinki Univ., Finland). 1973.

From Finnish summer school in nuclear physics, 1973; Liperi, Finland (11 Jun 1973).

Some preliminary results of a three-body model study of the ^{16}O + d collision are reported. The calculations were made using a general three-body code. In the three-body model several realistic features were included not present in previous studies. In particular the role of realistic bound state form factors and the effect of spectroscopic factors studied. A comparison of the results with experiments is also presented. (auth)

22616 (ITF-74-14P) SCHROEDINGER EQUATIONS FOR A WAVE FUNCTION OF COLLECTIVE EXCITATIONS IN THE EIGHT NUCLEON SYSTEM. Filippov, G. F. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1973. 19p. (In Russian). Dep. NTIS (U. S. Sales Only) $4.00.

The collective kinetic energy operator of ^8Be is obtained in a minimum approximation of the method of generalized hyperspheric functions as well as the expression for a collective wave function in the case of oscillator potential of internucleon interaction. (auth)

22617 (JINR-E4-7959) WAVE FUNCTIONS AND PARTICLE TRANSFER FORM FACTORS OF ^{42}Ca AND ^{18}O. Bang, E.; Gareev, F. A.; Yamaleev, R. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 27p. Dep. NTIS (US Sales Only) $4.50.

Wave functions and energies of 0^+ states of ^{42}Ca and ^{18}O are calculated, using an expansion of Sturm – Liouville functions. The method is an alternative to the inclusion of continuum wave functions in shell model calculations and represents a considerable simplification compared to the latter. The wave functions are used to calculate cross sections of two-particle transfer. (auth)

22618 (KHFTI-72-45, pp 32-35) STUDY ON π^-/π^+ RATIO ON ^{27}Al NUCLEUS IN THE ENERGY RANGE OF 300 TO 1200 MeV. Grishaev, I. A.; Krinitsyn, A. N.; Lapin, N. I.; Nikiforov, V. I.; Pugachev, G. D.; Shramenko, V. I. 1972. (In Russian).

The dependence of the π^-/π^+ ratio on ^{27}Al nuclei and on the pion energy was studied. The study was made for the purpose of studying the mechanism of the interaction of charged pions with nuclear material. The experiments were made on γ bremsstrahlung beams of the photon channel of the 2-MeV LUZ accelerator using the photoemulsion method. A comparison was made of the π^-/π^+ ratio for ^{27}Al nuclei and this ratio for deuterium. The data obtained was compared with the data of other authors. (tr-auth)

22619 (KHFTI-73-9, pp 25-27) EMISSION OF CHARGED PARTICLES IN MUON CAPTURE BY LIGHT NUCLEI. Vartanyan, V. A. (Inst. of Physics, Erevan); Ehramzhyan, R. A. 1973. (In Russian).

An analysis was made of the difference decay channels of the giant resonance state of ^6Li. The scheme of the excitation state of ^6Li and the spectrum of the tritium nucleus during decay of the giant resonance state were reported for the cases of photoabsorption and μ^- capture. (tr-auth)

22620 (KHFTI-73-9, pp 32-34) SPECTRUM AND ASYMMETRY OF FAST NEUTRONS AT THE MUON CAPTURE BY COMPLEX NUCLEI. Salganik, Yu. A.; Ehramzhyan, R. A. (Joint Inst. for Nuclear Research, Dubna, USSR). 1973. (In Russian).

The capture of muons by ^{16}O nuclei was examined. The neutron channels of the reaction $\mu^- + {}^{16}O \rightarrow {}^{15}N + n + \nu$ with formation of ^{15}N were studied in the ground and excited states. The energy spectra and the asymmetry of the angular distributions of neutrons emitted as a result of the reaction were calculated. (tr-auth)

22621 (KHFTI-73-9, pp 52-53) KNOCK-OUT REACTION IN QUASIELASTIC AND ANTI-QUASIELASTIC KINEMATICS. Balasanov, V. V.; Kabachnik, N. M.; Titarenko, N. M. (Inst. of Nuclear Physics, Moscow). 1973. (In Russian).

An example was given of the calculation of the spectrum of the reaction of knock-out reactions by electrons on ^{12}C (e,e'p) in the usual quasielastic and antiquasielastic kinematics. The calculation was made by the method of strong channel bonds. (tr-auth)

22622 (KHFTI-73-9, pp 54-56) INELASTIC ELECTRON SCATTERING IN THE RANGE OF ELECTROEXCITATION OF Δ_{1236} ISOBAR. Titov, Yu. I.; Stepula, E. V.; Afanas'ev, N. G.; Akhmerov, R. V.; Byvalin, S. A.; Severin, N. F.; Smelov, E. M. (Physical-Technical Inst., Kharkov). 1973. (In Russian).

The inelastic scattering cross section of electrons on the nuclei Be, Cu, and Ag at initial electron energies of 1185 MeV and scattering angles of 25, 30, and 35° was measured. The cross section on protons and deuterium was measured under the same conditions for possible comparison of the cross section on nuclei with the total cross section on individual nucleons. (tr-auth)

22623 (KHFTI-73-9, pp 57-61) INVESTIGATION OF PHOTON INTERACTION AT E_γ^{max} = 250 TO 1200 MeV WITH NUCLEI ^{12}C. Goncharov, N. V.; Derebchinskii, A. L.; Konovalov, O. G.; Tonapetyan, S. G.; Khvorostyan, V. M. (Physical-Technical Inst., Kharkov). 1973. (In Russian).

The photoproduction of π mesons on ^{12}C and the nature of the protons emerging at large angles ($\theta_{lab} > 60°$) was studied at photon energies above the threshold for the photoproduction of π mesons. The energy spectra of photoprotons for γ quanta with energy from 110 to 1200 MeV and π mesons for γ quanta with energy from 250 to 1200 MeV were obtained. The experimental and calculated values of the differential cross section of the photodisintegration of ^{12}C were compared. (tr-auth)

22624 (KHFTI-73-9, pp 64-66) STUDY OF (e,e'p) REACTION ON NUCLEI ^6Li WITH THE (e',p) COINCIDENCE RECORDING. Antuf'ev, Yu. P.; Agranovich, V. L.; Kuz'menko, V. S.; Miroshnichenko, I. I.; Sorokin, P. V. (Physical-Technical Inst., Kharkov). 1973. (In Russian).

The reaction $^6Li(e,e'p)^5He$ with energy resolution sufficient for separation of the effects of the individual shells of the ^6Li nucleus was experimentally studied for the first time. The reaction cross section was studied as a function of the deficient energy at two values of the deficient energy 4 and 20 MeV. The angular distribution of the protons was measured. (tr-auth)

22625 (KHFTI-73-9, pp 74-76) PHOTON INTERACTION AT E_γ^{max} = 400 MeV WITH ^6Li, ^7Li, ^9Be, ^{12}C, ^{28}Si, ^{40}Ca, ^{93}Nb, ^{181}Ta NUCLEI. Goncharov, N. V.; Derebchinskii, A. I.; Konovalov, O. G.; Tonapetyan, S. G.; Khvorostyan, S. G.; Khvorostyan, V. M. (Physical-Technical Inst., Kharkov). 1973. (In Russian).

The spectra of protons and pions emitted at angles of $\theta_{lab} = 90°$ were measured during the interaction of 400-MeV photons with ^6Li, ^7Li, ^9Be, ^{12}C, ^{28}Si, ^{40}Ca, ^{93}Nb, and ^{181}Ta. An analysis was made of the A-dependent yields of these particles. The direct dependence of the photoproduction cross section of pions on the mass number A of the nucleus indicated that the photoproduction of π mesons on nuclei occurs throughout the volume of the nucleus, but the proton yield at an angle of 90° is caused basically by the absorption of pions by the two-nucleon association in the nucleus. (tr-auth)

22626 (LBL-2938) EXOTIC REACTIONS IN THE LIGHT ELEMENTS. Cerny, J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jun 1974. Contract W-7405-eng-48. 18p. (CONF-740637-6). Dep. NTIS $4.00.

From international conference on reactions between complex nuclei; Nashville, Tennessee, USA (10 Jun 1974).

Recent in-beam experiments with heavy ions leading to mass measurements and spectroscopic studies of light nuclei very far from the region of beta stability are reviewed. The detection of resonance particles as low-yield reaction products is discussed first. Heavy-ion reactions producing multineutron final states are then taken up. Energy spectra are shown for the $^7Li(^7Li,^{11}B)T$, $^7Li(^7Li,^{11}C)3n$, and $^7Li(^7Li,^{10}C)4n$ reactions at 79.6 MeV. Several excited states were seen in the $(^7Li,^{11}B)$ reaction, but no structure was visible in the $(^7Li,^{11}C)$ reaction. Upper limits for the production of trineutrons and tetraneutrons in these experiments were 70 and 30 nb, respectively. Other multinucleon transfer reactions are then considered, with emphasis on two-proton-pickup reactions and exotic rearrangement reactions. Energy spectra are shown for the following reactions: $^{48}Ca(^6Li,^8B)^{46}Ar$ at 80 MeV; $(^6Li,^8B)$ on ^{11}B, ^9Be, and ^{12}C at 80 MeV; $(^{11}B,^8B)$ on ^{26}Mg and ^{28}Si at 86 MeV; $^{26}Mg(\alpha,^8He)^{22}Mg$ at 110 MeV; $(\alpha,^8He)$ on ^{12}C and ^{24}Mg at 156 MeV; $^{14}C(^{18}O,^{12}Be)^{20}Ne$ at 88.7 MeV; $^{24}Mg(^7Li,^6B)^{25}Ne$ at 78.9 MeV; and $^9Be(^9Be,^8B)^{10}Li$ at 120 MeV. Finally, predictions made by using the shell model and the relations of Garvey et al. are compared

with measured masses for $T_z = 5/2$ nuclei in the 2s–1d shell. (19 figures) (RWR)

22627 (NP-20044, pp 17-21) DWBA CALCULATIONS OF INELASTIC SCATTERINGS OF ^{12}C AND ^{14}N. Kohno, I. Dec 1973.

22628 (NP-20044, pp 47-50) TWO-STEP PROCESS IN THE $^{12}C(^3He,\alpha)^{11}C$ REACTION. Yamaji, S.; Fujisawa, T.; Motonaga, S.; Yoshida, F.; Sakaguchi, H.; Masui, K. Dec 1973.

22629 (NP-20044, pp 126-128) MEASUREMENT OF EXCITATION CURVES FOR THE FORMATION OF MEDICAL-USE RADIOISOTOPES. Nozaki, T.; Karasawa, T.; Okano, M.; Iwamoto, M.; Hara, T. Dec 1973.

22630 (RUB-TP-2/80) ELECTRIC DIPOLE SUM RULE FOR LIGHT, EVEN–EVEN NUCLEI VIA BRUECKNER–HARTREE–FOCK (BHF) WAVE FUNCTIONS. Gari, M.; Hebach, H.; Fink, M. (Bochum Univ. (F. R. Germany). Inst. fuer Theoretische Physik). Jan 1974. 10p. INIS.

We present calculations of the enhancement factor K in the electric dipole sum done by the use of solutions of the Brueckner–Hartree–Fock (BHF) equations. Results are given for ^4He, ^{12}C and ^{16}O for various realistic nucleon–nucleon potentials. (1 figure, 2 tables) (auth)

22631 (UCRL-51603) EVALUATED NEUTRON-INTERACTION AND GAMMA-RAY-PRODUCTION CROSS SECTIONS OF ^9Be FOR ENDF/B-IV. MAT No. 1289. Howerton, R. J.; Perkins, S. T. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 18 Jun 1974. Contract W-7405-eng-48. 16p. Dep. NTIS $4.00.

The methods used to produce evaluated neutron-interaction and photon-production cross sections for ENDF/B-IV are discussed. This evaluation is identical with the Be evaluation in the Defense Nuclear Agency working cross section library, MAT 4154. The evaluated neutron-interaction data have been tested by comparing calculated with experimental parameters for appropriate integral experiments. (auth)

22632 (ZfK-262, pp 4-5) ENERGY DEPENDENCE OF THE EXCITATION CROSS SECTION FOR DEUTERON KNOCK-OUT FROM Li, Be, AND C WITH PROTONS IN THE ENERGY REGION 380 TO 665 MeV. Komarov, V. I.; Kosarev, G. E.; Reshetnikov, G. P.; Savchenko, O. V.; Tesh, Z. (Joint Inst. for Nuclear Research, Dubna, USSR). Sep 1973. (In German).

22633 EXTERNAL EFFECTS ON RADIOACTIVE HALF-LIFE. Shimizu, S. (Kyoto Univ., Uji, Japan). Radioisotopes (Tokyo); 22: No. 8, 455-465(Aug 1973). (In Japanese).

This paper reviews the attempt to change decay constants (λ) of radioactive nuclei. Among various decay modes, the electron internal conversion process and shell electron capture are under the strong influence of shell electron wave function. Therefore, it is possible to change the decay constants by varying the form of the compound containing the atoms. Measurement of variation of the decay constants (λ) is usually made by a method proposed by Rutherford, since the variation is small. The variation of λ due to the difference of chemical form was first measured with ^7Be. This element decays through the electron capture process to the 477 keV level of ^7Li. The electron density, which exerts strong influence on the electron capture process, can hardly be estimated, but seems to be changed due to the chemical form. The order of electron density is considered as follows: Be (metal) > BeO > BeF_2. Bouchez et al. reported the difference of λ between ^7Be in the form of metal and $^7BeF_2$ in 1948. In 1948, Segré and Wiegand measured the difference between λ_{BeO} and $\lambda_{Be\text{-}metal}$ by Rutherford's method. The change of decay constants due to the chemical form or surrounding conditions was observed for $^{95}_{41}Zr$, $^{89}_{38}Sr$, and $^{64}_{29}Cu$, which decay through the electron capture process. A small difference among the decay constants of $^{99m}_{43}Tc$, which decays through the internal conversion process, in metallic form, $KTcO_4$, and Tc_2S_7 was reported in 1951 by Goldhaber et al. The change in ^{99m}Tc under high pressure was estimated by Porter and McMilland and observed by Shimizu et al. Other elements decaying through the internal conversion process and having shown the variation of λ due to the chemical form are $^{93m}_{41}Nb$, $^{235m}_{92}U$, $^{125m}_{52}Tc$ and $^{193}_{78}Pt$. (JA)

22634 INELASTIC NEUTRON SCATTERING IN ^{19}F. Rogers, V. C. (Intelcom Rad Tech., San Diego, CA). Phys. Rev., C; 9: No. 2, 527-530(Feb 1974).

Measurements of γ rays from the $^{19}F(n,n'\gamma)$ reaction have been performed with 0.2–1.7-MeV incident neutrons. The measured 110- and 197-keV level excitation functions, magnetic sub-state populations, and γ-ray angular distributions are generally consistent with compound-nuclear calculations. Although the experimental values of the 197-keV level excitation function are also consistent with a 15% direct-interaction component, the corresponding magnetic sub-state populations and 197-keV γ-ray angular distributions are not sensitive to this component. (auth)

22635 MEASUREMENT OF THE RADIATIVE WIDTH OF THE 12.71-MeV LEVEL IN ^{12}C. Cecil, F. E. (State Univ. of New York, Stony Brook); Fagg, L. W.; Bendel, W. L.; Jones, E. C. Jr. Phys. Rev., C; 9: No. 2, 798-799(Feb 1974).

The ground-state magnetic dipole transition width of the 1^+ level at 12.71 MeV in ^{12}C has been measured to be 0.35 ± 0.05 eV. This value is used to calculate the total width of the level based on a previous measurement of the relative ground-state γ width. A total width of 14.6 ± 2.6 eV is thus calculated. A model-dependent measurement of the isospin mixing between this level and the 15.11-MeV level yields the values $\beta = 0.19 \pm 0.01$ or 0.05 ± 0.01. (auth)

22636 PREDICTED PROTON SPECTRUM AT FORWARD ANGLES FOR 29.4-GeV NITROGEN ON CARBON. Bertini, H. W.; Gabriel, T. A.; Santoro, R. T. (Oak Ridge National Lab., TN). Phys. Rev., C; 9: No. 2, 522-526(Feb 1974).

The proton spectrum over the angular interval of 0 to 10 mrad from the interactions of 29.4-GeV nitrogen on carbon has been calculated. The differential cross section for the emission of protons indicates that there is a significant number of emitted protons with energies greater than the energy per nucleon of the incident projectile (2.1 GeV). A description of the calculational method is included. (auth)

22637 ISOSPIN BREAKING IN THE REACTIONS $^3H + {}^9Be \rightarrow {}^6Li + {}^6He$, $^6Li^* + {}^6He$. Cannata, F.; Werntz, C. (Catholic Univ. of America, Washington, DC). Phys. Rev., C; 9: No. 2, 782-783 (Feb 1974).

In the reactions $^9Be(t,{}^6Li){}^6He$ and $^9Be(t,{}^6Li^*(3.56)){}^6He$ significant deviations of the cross sections from symmetry around 90° are seen in the isospin multiplet channel. One may interpret this deviation as arising from the difference between ^6He and $^6Li^*$ radial wave functions and not from a higher mixture of isospin states. This interpretation is supported by a recent muon-capture analysis. (auth)

22638 CROSS SECTIONS FOR (π^+,p) REACTIONS ON ^6Li, ^9Be, ^{12}C, AND ^{16}O. Amato, J. (Los Alamos Scientific Lab., NM); Burman, R. L.; Macek, R.; Oostens, J.; Shlaer, W.; Arthur, E.; Sobottka, S.; Lam, W. C. Phys. Rev., C; 9: No. 2, 501-507 (Feb 1974).

Measurements of the (π^+,p) reaction on ^6Li, ^9Be, ^{12}C, and ^{16}O have been made for 70-MeV pions. A magnetic spectrometer was used to momentum analyze the pion beam while thick NaI(Tl) detectors were used to determine the proton energy. The experimental resolution was 3 MeV. Data from the ^9Be and ^{16}O targets were taken around a laboratory scattering angle of 25°. The number of (π^+,p) events from these nuclei was not significantly greater than background contributions, and therefore upper limits on the cross section are presented. Data from the $^{12}C(\pi^+,p)^{11}C$ reaction were obtained at proton emission angles of 20 and 32° (lab), while for ^6Li, measurements were made over the angular range from 33 to 90°. The experimental cross section for the $^{12}C(\pi^+,p)^{11}C$ reaction, obtained by integrating over ^{11}C excitation energies from 0 to 8 MeV, did not agree well with existing theoretical predictions. Results from the $^6Li(\pi^+,p)^5Li$ reaction indicated excitation of the $p_{\frac{1}{2}}$ state of ^5Li. The cross section for this reaction decreased rapidly for emission angles less than 60°, while at larger angles the cross section was constant within the measured range. (auth)

22639 ALPHA-CLUSTER LEVELS IN ^{15}O AS SEEN IN THE REACTION $^{14}N(p,\alpha_0)^{11}C$. Huttlin, G. A.; Rollefson, A. A. (Univ. of Notre Dame, IN). Phys. Rev., C; 9: No. 2, 576-580(Feb 1974).

Excitation functions and angular distributions of $^{14}N(p,\alpha_0)^{11}C$ for bombarding energies of 9.0 through 12.0 MeV have been measured in steps of 50 keV from 10 through 160°. Prominent structures are noted near excitations of 16.2, 17.2, and 17.8 MeV in ^{15}O and are observed to be composed of many sub-structures. Legendre polynomial fits to the angular distributions have been made. Corresponding structures are noted in the $^{12}C(^3He,\alpha_0)^{11}C$ reaction and comparisons are made with the α-particle core-excited threshold-state model which had been applied to ^{15}O. (auth)

22640 STRUCTURE CALCULATIONS IN ^{18}O NUCLEUS. De, J. N.; Pal, M. K. (Saha Inst. of Nuclear Physics, Calcutta). Pramana; 2: No. 4, 199-218 (Apr 1974).

A multishell Hartree–Fock calculation for ^{18}O nucleus was done with the Tabakin and Hamada–Johnston interactions followed by pairing correlations and angular momentum projection. The

B(E2) transition rates were reproduced with an effective charge of 1.5e for protons and 0.5e for neutrons, but the fit to energy levels is poor. An approximate alternative formalism was then developed which casts the eighteen-particle problem into a two-valence nucleon problem. The two valence nucleons interact through the RPA-type oscillation modes of the core. Calculations with the two interactions mentioned above have reproduced roughly the uncorrelated projected Hartree–Fock spectrum. Lastly, the excited band spectra of ^{18}O were examined in the TDA approach followed by band mixing. (auth)

22641 INVESTIGATION OF PROXIMITY SCATTERING IN THE $^{7}Li(d, n\alpha)\alpha$ AND $^{12}C(d, np)^{12}C$ REACTIONS. Sharma, T. C. Edmonton, Alberta; Univ. of Alberta (1972). 99p.

Thesis.

The reaction $^{7}Li(d, n\alpha)\alpha$ was investigated in search of $n-\alpha$ proximity scattering at incident deuteron energies between 1.90 and 2.10 MeV. Effects attributed to rescattering following the formation of the resonance state at 16.63 MeV in $^{8}Be^{*}$ are not observed. Strong lines due to randoms were seen in the vicinity of the proximity scattering positions on the kinematic locus. Data were fitted with the Breit–Wigner line shape plus a linear background. Conditions affecting the observation of such a rescattering are discussed. Another reaction, $^{12}C(d, np)^{12}C$, was studied to look for evidence of the existence of proximity scattering between the first emitted neutron and a proton emitted from the decaying 3.5 MeV doublet in $^{13}N^{*}$. The data at incident deuteron energies E_d = 5.2, 5.4 and 5.75 MeV and E_d = 5.1, 5.26 and 5.4 MeV at two sets of angles show the energy dependence of the proximity scattering. The data taken at 6.25 MeV, where rescattering is kinematically disallowed, show no enhancement. The data at E_d = 5.4 and angle setting $\theta_n = \theta_p = 0°$, $\phi_{np} = 35°$ also support theoretical predictions made by Aitchison and Kacser. The data at E_d = 5.4 MeV do not give a good fit with a Breit–Wigner line shape plus $n-p$ final state interaction, and it has been concluded that the singlet and triplet states of the deuteron do not contribute significantly to the observed rescattering enhancement. In the $^{28}Si(d, np)^{28}Si$ reaction, no estimate of the contribution due to proximity scattering could be made because of interfering sequential decays. (auth)

22642 PRODUCTION OF LITHIUM AND BORON ISOTOPES IN LOW ENERGY PROTON AND ALPHA PARTICLE BOMBARDMENT OF NITROGEN. Jacobs, W. W. Seattle; University of Washington (1974). 141p. University Microfilms Order No. 74-15,516.

Thesis (Ph. D.).

The proton reactions $^{14}N(p,2\alpha)^{7}Be$ and $^{14}N(p,\alpha)^{11}C$ and alpha particle reactions $^{14}N(\alpha,3\alpha)^{6}Li$ and $^{14}N(\alpha,2\alpha)^{10}B$ were studied near their energy threshold because of the possible importance of these reactions in production of the light elements LiBeB by low-energy particle fluxes. The proton reaction cross sections were measured by standard activation techniques. The ^{7}Be yield was measured up to an incident proton energy of 24 MeV by counting the 478-keV gamma rays emitted following the 53.6-day decay of ^{7}Be. The ^{11}C yield was measured up to 22 MeV by coincidence counting of the 20.3-minute 511-keV annihilation gamma rays from the positron decay of ^{11}C. The cross sections found for the ^{11}C yield are in some disagreement with those from previous measurements in the same energy region, although the ^{7}Be results are in good agreement. The alpha particle-induced cross sections were measured at incident energies from 21 to 42 MeV by integrating angular distributions of the recoiling reaction products. These products, primarily ^{6}Li and ^{10}B, were identified by time-of-flight techniques. Yields of the light elements from interactions with CNO nuclei were examined by using cross sections found in the present work as well as by other investigators. The possible conclusions depend strongly upon the presently uncertain cosmic boron abundance. If estimates suggesting a high boron abundance are correct, then it is found possible to account for the $^{7}Li/^{6}Li$, $^{11}B/^{10}B$, and B/Li ratios found in nature in terms of reactions dominated by protons below 25 MeV. (Diss. Abstr. Int., B)

22643 MULTIPLICITY AND CORRELATIONS OF SECONDARY PARTICLES PRODUCED IN π^- ^{12}C COLLISIONS AT P = 40 GeV/c. Grishin, V. G.; Inogamova, T. Ya.; Inogamov, Sh. V. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 19: No. 6, 1364-1371(Jun 1974). (In Russian).

Analysis of the multiplicity distributions for secondary charged particles in π^- ^{12}C interactions at p = 40 GeV/c shows that the distributions are described qualitatively by means of the Poisson and Poya formulas. The multiplicity data on π^- ^{12}C interactions are described by the same universal curve that the results on π^-p and pp interactions (the multiplicity scaling). Increase of the average multiplicity of the charged particles with the energy satisfies the logarithmic law for the π^- ^{12}C and π^-p interactions with the same slope parameters. Correlation in the neutral and charged pion production for the π^- ^{12}C interactions is of the form $\langle n_\pi^0 \rangle = (1.64 \pm 0.11) + (0.16 \pm 0.02)n_s$, while the coefficients coincide with their analogs in case for the π^-p and π^-n interactions at p = 40 GeV/c. Hence one may conclude that the secondary interactions are inessential for the observed phenomenon. (auth)

22644 STUDY OF THE INTERMEDIATE ^{5}Li GROUND STATE PRODUCED IN THE $^{6}Li(^{3}He,\alpha p)^{4}He$ REACTION. Livesley, D. L. (Univ. of New Brunswick, Fredericton); Piluso, C. J. Can. J. Phys.; 52: No. 13, 1167-1172(1 Jul 1974).

An experiment has been performed on alpha–proton coincidences produced by the three-body reaction $^{6}Li(^{3}He,\alpha p)^{4}He$, at a bombarding energy of 1.25 MeV. Events ascribed to sequential breakup via the ground state of ^{5}Li have been isolated with the aim of measuring the angular distribution of protons derived from ^{5}Li. Difficulties are encountered because the alpha particle spectra in coincidence with the detected protons vary significantly with the proton angle. Possible interpretations of this effect are discussed. A tentative angular distribution, based on a compromise interpretation, shows a pronounced minimum which is shifted away from the ^{5}Li recoil direction. Similar shifts have been detected in the $^{7}Li(d,\alpha n)^{4}He$ reaction by Heggie and Martin, who explained the directional correlation effects in terms of a compound nucleus model. This model seems to be more applicable to these reactions than models based on stripping and pickup processes. (auth)

22645 STUDY OF GAMMA-RAY TRANSITION IN ^{21}Ne BY THE $^{19}F(^{3}He,p\gamma)$ REACTIONS. Lawson, J. C. Notre Dame, IN; University of Notre Dame (1973). 189p. University Microfilms Order No. 74-14,854.

Thesis (Ph. D.).

Excited states of the nucleus ^{21}Ne were studied by particle-γ angular correlations in axial geometry. The reaction $^{19}F(^{3}He, p\gamma)^{21}Ne$ was produced with beam energies of 3.5-7.0 MeV. A multiple NaI detector system was used. An on-line computer was programmed to store the data in two-parameter form on a disk. Coding of a large computer was developed in order to extract intensities of peaks in the spectra of the several γ-ray detectors. The spectra could optionally be first combined. Further coding was developed to analyze simultaneously the correlations from several related transitions and from several data sets. Most reported γ-ray decays from levels below 7 MeV in excitation were verified. Fourteen new decays were found. Spin assignments or limitations were made. Results were discussed in terms of rotational bands. New γ-ray branches of the 3.88, 5.823 and 6.27 MeV levels confirmed the existence of a $K^\pi = \frac{1}{2}^-$ band based on the $J^\pi = \frac{1}{2}^-$, 2.79 MeV level. The spin and parity of the 5.823 MeV level were tentatively assigned as $J^\pi = \frac{1}{2}^-$ on this basis. The 6.27 MeV level was found to have spin $J = \frac{5}{2}$ with high probability. The 4.69 MeV level was found to have a new branch to the $\frac{1}{2}^+$, 2.80 MeV level and to have a spin $J = \frac{3}{2}$, both results being consistent with members of a $K^\pi = \frac{1}{2}^+$ rotational band. The 5.55 MeV level with assignment $J^\pi = \frac{3}{2}^+, \frac{5}{2}^+$, was found to have unreported branches to the 2.79, 2.80, 3.73 and 4.53 MeV levels. These branches and the angular correlations of the 5.55 → 2.80 transition indicated a probable spin $J = \frac{3}{2}$. A new decay of the 5.69 MeV level to the 4.73 MeV level, with respective assignments $J^\pi = \frac{1}{2}^-$ or $\frac{3}{2}^-$ and $J^\pi = \frac{1}{2}^-$, gave good evidence of an inverted $K = \frac{1}{2}^-$ rotational band. New limitations were given for the spins of levels at 5.43, 6.18, and 6.64 MeV. The structure of ^{21}Ne was compared with that of ^{22}Na. The degree of success of some shell model calculations was noted. (Diss. Abstr. Int., B)

22646 SMALL-ANGLE SCATTERING OF 7.4- TO 9.5-MeV NEUTRONS FOR NITROGEN AND OXYGEN. Bucher, W. P.; Hollandsworth, C. E.; McNatt, D.; Lamoreaux, R.; Niiler, A.; Youngblood, J. E. (Army Ballistic Research Labs., Aberdeen Proving Ground, MD). Nucl. Sci. Eng.; 54: No. 4, 416-422(Aug 1974).

Cross sections were measured for the elastic scattering of 7.40-, 7.55-, 8.00-, 8.55-, 9.00-, and 9.50-MeV neutrons from nitrogen and oxygen in the angular range from 2.5 to 15 deg. The results for nitrogen show a much stronger scattering at small angles than previously inferred by extrapolation from large-angle scattering data. (4 figures, 2 tables) (auth)

22647 QUASI-FREE BACKGROUND FOR TOTAL PHOTOABSORPTION CROSS SECTIONS. Cannata, F. (Catholic Univ. of America, Washington, DC); Ueberall, H. Lett. Nuovo Cim.; 10: No. 15, 645-648(10 Aug 1974).

It is shown that, if applied to the photoabsorption problem, the Perey effect largely suppresses the E1 contribution of the quasi-free-nucleon model. The remaining contribution provides a higher-multipolarity background to the giant dipole resonance, which has to be added to the calculated shell-model E1 strength. This indicates that the dipole photoeffect cannot be accounted for by the

quasi-free model. The calculation proceeds by evaluating the matrix element of the electromagnetic transition operator between plane-wave states, and then averaging over the ground-state momentum distributions in a harmonic oscillator model, while describing the internucleon effects by the use of an effective mass. Experimental data on the total photoabsorption cross section in ^{12}C are plotted from 15 to 35 MeV, along with the calculated background and the dipole cross section of the collective-correlation model (reduced by 20%) and added to the background. It is found that the background amounts to 25% of the total; this fact could be important if one wants to make comparisons of experimental photoabsorption cross sections with dipole sum rules. In contrast to this, short-range correlations in the nuclear ground state should not strongly affect the photoabsorption cross section in the region below 30 MeV. (1 figure, 1 table) (RWR)

22648 SEARCH FOR PARITY-NONCONSERVING EFFECTS IN THE $^{12}C(\alpha,\gamma)^{16}O$ REACTION. Bellotti, E.; Fiorini, E.; Negri, P. (Univ., Milan). pp 63-66 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973). See CONF-730642-.

Parity-non-conserving reactions $^{12}C(\alpha,\gamma)^{16}O$ leading to the ($J^\pi = 0^-$; I = 0) level at 10.952 MeV and to the (3^+,0) level at 11.080 MeV of ^{16}O were searched for. These levels should be much favored due to parity mixing with near levels with the same spin and isospin and opposite parity. Targets enriched to 99.9% ^{12}C have been exposed to beams of α-particles and the emitted γ-rays were detected with a 75 cm^3 Ge(Li). No evidence for the parity-forbidden states appears in the γ-spectra and one can set with 80% confidence level upper limits of 6×10^{-4} eV and 5×10^{-4} eV for the parity-violating widths of the 10.952 and 11.080 levels, respectively. The corresponding limits on the parity-non-conserving parameter F are $F^2 < 2 \times 10^{-10}$ and $F^2 < 6 \times 10^{-10}$, respectively. (auth)

22649 COHERENT PRODUCTION OF $K^+\pi^+\pi^-$ ON NUCLEI AND DETERMINATION OF THE $K^+\pi^+\pi^-$–NUCLEON CROSS SECTION. Bemporad, C. (CERN, Geneva); Beusch, W.; Dufey, J. P.; Polgar, E.; Websdale, D.; Zaimidaroga, O.; Fluri, L.; Freudenreich, K.; Genitit, F. X.; Muehlemann, P. pp 127-130 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973). See CONF-730642-.

Coherent production of $K^+\pi^+\pi^-$ on nuclei at 10, 13 and 16 GeV/c has been observed. The differential cross-section is well fitted by an optical model. The $K^+\pi^+\pi^-$ mass distribution shows a structureless Q bump; the K^+ mass has been assigned to one of the two positive particles by a K* selection. The total cross-section of the $K^+\pi^+\pi^-$ system on a nucleon is found to be 22 mb. (auth)

22650 PARTIAL WAVE ANALYSIS OF THE 3π STATES COHERENTLY PRODUCED ON NUCLEI. Bemporad, C. (CERN, Geneva); Beusch, W.; Websdale, D.; Freundenreich, K.; Muehlemann, P.; Pernegr, J.; Wetzel, W.; Bellini, G.; di Corato, M.; Palombo, F. pp 131-132 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973). See CONF-730642-.

A preliminary spin-parity analysis of the $\pi^+\pi^-\pi^-$ system, produced coherently on nuclei, shows predominance of the 1^+ state, some admixture of 0^- and absence of the 1^-, 2^+ ... natural parity series. Evidence for the absorption of the 0^- final state in nuclear matter being substantially larger than that of the 1^+ state is presented. (auth)

22651 MEASUREMENT OF 3π MASS SPECTRUM IN THE REACTION $\pi^-{}^{12}C \rightarrow \pi^-\pi^-\pi^+{}^{12}C^*(4.44\ MeV)$. Ascoli, G.; Chapin, T.; Holloway, L. E.; Koester, L. J. Jr.; Kruse, U. E.; Nodulman, L. J.; Wojslaw, R. (Univ. of Illinois, Urbana). pp 147-150 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973). See CONF-730642-.

The Argonne Effective Mass Spectrometer was used in a 6 GeV/c beam to measure the 3π mass spectrum in coincidence with the 4.44 MeV C* γ-ray from the reaction $\pi^-{}^{12}C \rightarrow \pi^-\pi^+\pi^-{}^{12}C^*$. Over 2,000 good events were obtained. The preliminary mass distribution peaks around the A_1 meson. For these events, the γ flight time distribution excludes neutrons, and the missing mass is that of $^{12}C \pm 70$ MeV. The t distribution shows a dip in the forward direction and falls exponentially at large |t| values. On-line analysis yielded an integrated cross section of 0.2 mb for this $3\pi C^*$ production, i.e. 10% of the πC^* single scattering. (auth)

22652 ELASTIC AND INELASTIC SCATTERING OF 1 GeV PROTONS. Thirion, J. (CEN de Saclay, Gif-sur-Yvette, France). pp 168-175 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973). See CONF-730642-.

(1) Elastic and inelastic scattering of 1 GeV protons: the facility, SPES I, is a spectrometer used in the energy loss type with the following characteristics: best measured resolution 100 keV; solid angle 3×10^{-3} sr; momenta up to 2 GeV/c; localizations on the focal plane are obtained with an array of 50 cm drift counters (1 mm precision); zero time is given by a telescope of scintillation and Cherenkov counters. Data have been obtained for ^{12}C, ^{58}Ni, ^{208}Pb, ^{16}O, ^{40}Ca. Analysis of the Glauber and KMT type is in progress; difficulties for large momentum transfers are observed. Near future should provide data for ^6Li, ^4He, ^{24}Mg. (2) Future use of SPES I: Study of large momentum transfers by pπ (two body) and pd reactions. (3) Second facility SPES II: A QD2 type: Spectrometer (momenta up to 700 MeV/c; $\Omega = 2 \times 10^{-2}$ sr; focal plane $\Delta p/p = \pm 18\%$) is under construction and will be installed separately next year. Experiments could be pπ (two body or three body type), ppK (with the two particles detected at 0° in the spectrometer). (4) Accelerator improvements: Present intensity is 5×10^{10}/pulse in the beam analyzer acceptance; $\Delta E/E = 400$ keV. Extraction length = 200 msec. Plans for improvement include a rebuilding with strong focusing and more rapid cycling. Intensity in the analyzer acceptance should reach $\sim 10^{12}$/sec. Energy will be variable, as now, from 5 to 3 GeV. (auth)

22653 π^+ AND π^- TOTAL CROSS SECTIONS FOR ^6Li, ^7Li, ^9Be, C, AND O FROM 90 TO 860 MeV. Clough, A. S. (Univ. of Surrey, Guildford, Eng.); Turner, G. K.; Allardyce, B. W.; Batty, C. J.; Baugh, D. J.; McDonald, W. J.; Riddle, R. A. J.; Watson, L. H.; Cage, M. E.; Pyle, G. J. pp 213-218 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973). See CONF-730642-.

Total cross sections for $\pi^\pm$-mesons have been measured for ^6Li, ^7Li, ^9Be and C from 90 to 860 MeV and for 0 from 90 to 230 MeV. Coulomb corrections to the data are discussed together with the effects of the distortion of the pion wave-function by the Coulomb field. The results are analyzed using dispersion relations to give values of the real part of the forward scattering amplitude and the effective pion-nucleus coupling constant. The results are also compared with predictions from the optical model. (auth)

22654 PION CHARGE EXCHANGE REACTIONS. Zaider, M.; Alster, J.; Ashery, D.; Auerbach, N.; Cochavi, S.; Moinester, M. A.; Warszawski, J.; Yavin, A. I. (Tel Aviv Univ., Israel). pp 219-222 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973). See CONF-730642-.

Published calculations and data for pion single charge-exchange are presented and lead to some open questions. The results of measurements of the cross section for the reactions $^{13}C(\pi^+,\pi^0)^{13}N$ and $^{11}B(\pi^+,\pi^0)^{11}C$ over the energy range of 30 to 90 MeV by an activation method are reported. The data for ^{13}C correspond solely to the excitation of the ground state analog. The excitation curve for ^{13}C is flat, in disagreement with available predictions for analog state transitions, using either plane wave or non-local optical potentials, but can be explained by a local optical potential. (auth)

22655 PION PRODUCTION ON NUCLEI AT 185 MeV. Dahlgren, S.; Grafstroem, P.; Hoeistad, B.; Asberg, A. (Univ. of Uppsala). pp 254-261 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973). See CONF-730642-.

Pion production on nuclei with the residual nucleus left in the ground state or an excited state has been studied with 185 MeV protons. Energy spectra of pions, in the energy range 17 to 48 MeV

and in the angular region 15–130° (lab), were measured with a magnetic spectrometer and a system of scintillation counters. Positive pion spectra have been recorded from the target nuclei ^{13}C, ^{16}O, ^{28}Si, and ^{40}Ca. Angular distributions for pion production leading to individual states of the residual nuclei are presented. Negative pion production from ^{12}C leading to the ground state of ^{14}C are also presented. A calculation based on a one-nucleon reaction model are compared with improved experimental results from pion production on ^{12}C. (auth)

22656 SINGLE PION PRODUCTION IN PROTON NUCLEUS COLLISIONS. Locher, M. P. (SIN, Villigen, Switzerland). pp 262-269 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973). See CONF-730642-.

Theoretical calculations in the context of the 185 MeV Uppsala experiment on (p,π) reactions into bound nuclear final states are reviewed. The evidence that the reaction mechanism at this energy is dominated by processes involving two or more nucleons is discussed. Standard DWBA is compared to treatments involving the two-particle dynamics explicitly. The high sensitivity of the (p,π) reaction to nuclear structure is demonstrated for a model involving intermediate NN^* formation. Off-shell effects, multiple scattering and the exclusion principle are discussed. (auth)

22657 (p,π^+) REACTION AND NUCLEAR STRUCTURE. Eisenberg, J. M.; Noble, J. V.; Weber, H. J. (Univ. of Virginia, Charlottesville). pp 270-273 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973). See CONF-730642-.

The (p,π^+) reaction was studied at 185 MeV and 600 MeV in distorted wave Born approximation (DWBA) to compare with recent experiments. Eikonal and Sopkovich formalisms were applied in order to minimize off-shell effects. Using Eckart wave functions to insure appropriate asymptotic behavior for single-particle bound states, cross sections of correct size, but wrong shapes, within reasonable ranges of nuclear size parameters were produced. The consequences of modifying the single-particle bound-state wave functions, and the effects of collective admixtures were examined; both are significant. Thus, there are a sufficient number of ambiguities in the theory that it is difficult to extract definitive information on the behavior of nuclear wave functions at small distances. (auth)

22658 CONSISTENT ANALYSIS OF THE PRODUCTION AND ABSORPTION OF PIONS NEAR THRESHOLD. Dillig, M.; Huber, M. G. (Univ. of Erlangen-Nurenberg, Ger.). pp 274-278 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973). See CONF-730642-.

In the framework of the Jastrow Model the proton induced production of π^+ and π^- at E_p = 185 MeV as well as the two nucleon absorption of bound π^- has been analyzed using the nonrelativistic, Galilei invariant pion nucleon interaction. It turns out that short-ranged nucleon–nucleon correlations do change the Independent Particle Model (IPM) predictions drastically: (1) the $^{12}C(p,\pi^+)$ reaction is enhanced roughly by two orders of magnitude, in general agreement with the experimental observation; (2) in the same model a mechanism for the (p,π^-) reaction is provided: with the same assumptions it is possible to reproduce both the magnitude and the angular distribution of negatively charged pions; (3) the two-nucleon absorption mechanism of this model accounts quantitatively for the lifetime of bound π^- in light nuclei, i.e., of the widths of π-mesic atoms. It can be concluded that short ranged correlations between nucleons play an important role in π induced reactions: more detailed experimental information about such reactions may yield valuable information on both the nuclear structure properties and on the π-nucleon interaction Hamiltonian. (auth)

22659 CROSS SECTIONS FOR π^0 FROM ^3He ON COMPLEX NUCLEI. Wall, N. S.; Craig, J. N.; Berg, R. E.; Ezrow, D.; Holmgren, H. D. (Univ. of Maryland, College Park). pp 279-281 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973). See CONF-730642-.

The cross section for π^0 production by high energy ^3He on nuclei has been measured. The results are given and compared with theory giving an indication of a large (~10^2) discrepancy. (auth)

22660 DEEP-LYING HOLE STATES STUDIED IN (p,d) REACTIONS. Kaelne, J.; Fagerstroem, B. (Univ. of Uppsala). pp 369-378 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973). See CONF-730642-.

Results from (p,d) studies of nuclei between ^{12}C and ^{40}Ca are presented. At E_p = 185 MeV separation energy (E_s) spectra were measured down to $E_s \simeq 80$ MeV which thus covered the region of binding energies for the inner shells 1s and 1p as measured by quasi-free-scattering (e.g., (p,2p)) experiments. Comparisons show that there is a clear resemblance between E_s-spectra of (p,2p) and (p,d). The 1s and 1p nucleons claimed to have been observed in (p,2p) would thus for the first time have been observed in pick-up. The present experiment indicates that the large internal widths connected with the "1s" and "1p" states may have a multi-component structure. For a few target nuclei E_s-spectra were recorded at different angles giving angular distributions in agreement with DWBA calculations. (auth)

22661 (p,pd) REACTION ON ^6Li AT 590 MeV. Kitching, P.; Olsen, W. C.; Dollhopf, W.; Lunke, C.; Perdrisat, C. F.; Priest, J. R.; Roberts, W. K. (Space Radiation Effects Lab., Newport News, VA). pp 379-382 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973). See CONF-730642-.

In a kinematically complete experiment with 590 MeV protons, the reaction $^6Li(p,pd)$ has been studied for recoil momenta up to 240 MeV/c. When the results are interpreted in terms of the Plane Wave Impulse Approximation (PWIA), it is found that the number of α-d clusters in ^6Li is 0.78 ± 0.10. If the momentum distribution is fitted with a Gaussian of the form $e^{-(q/q_0)^2}$, the best fit is obtained with a width parameter q_0 = 73 ± 1.6 MeV/c, in agreement with previous results at lower recoil momenta. (auth)

22662 KINETIC AND SEPARATION ENERGIES OF BOUND PROTONS FROM (e,e'p) REACTIONS. Bernheim, M.; Bussiere, A.; Gillebert, A.; Mougey, J.; Phan Xuan Ho; Priou, M; Royer, D.; Sick, I.; Wagner, G. J. (CEN de Saclay, Gif-sur-Yvette, France). pp 387-390 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973). See CONF-730642-.

The (e,e'p) reactions on ^{12}C, ^{28}Si, ^{40}Ca and ^{58}Ni have been measured at 500 MeV. The analysis of the carbon data including distorted wave corrections shows significant deviations from a Hartree–Fock picture of the nucleus. (auth)

22663 STABLE NUCLEI. Klapisch, R. (CNRS, Orsay, France). J. Phys. (Paris), Colloq.; 4, 1-4(1973). (In French).

From Centenary congress on the French Physical Society; Vittel, France (28 May 1974).

The concepts underlying the stability of neutron-rich light nuclei and the proposed region of superheavy nuclei are briefly reviewed. (FR)

Nuclear Properties and Reactions, 20 ≤ A ≤ 38

Refer also to abstracts 22243, 22584, 22626, 22627, 22641, 22645, 22649, 22650, 22655, 22660, 22662, 22663, 22680, 22681, 22689, 22703, 22720, 22721, 22748, 22749, and 22824.

22664 (COO-3196-44, pp 71-76) LEVEL WIDTHS OF T = 0 AND T = 1 ISOSPIN STATES OF ^{30}P AT AN EXCITATION ENERGY OF 19.6 MeV. Kildir, M.; Hulzenga, J. R. 1974.

In studies of nuclear fission, low-energy nuclear reactions and transuranic nuclei.

22665 (IKF-32, pp 6-8) STUDY OF THE (^3He,p) REACTION ON ^{29}Si AND ^{30}Si IN COOPERATION WITH THE MPI FUER KERNPHYSIK IN HEIDELBERG. Nann, H.; Duhm, H. H.; Friedland, U.; Hafner, H.; Hubert, B.; Patscher, W.; Wildenthal, B. H. 1973. (In German).

22666 (IPC-N-7303) ANGULAR MOMENTUM DEPENDENCE OF THE ELASTIC SCATTERING OF ALPHA PARTICLES. Lega, J. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)). 1973. 82p. (In French). INIS.

Thesis.

For certain nuclei at particular energies in the entrance channel, elastic scattering at large angles appears to show a very strong closing of the reaction channels. Why the rises at back angles appear only for certain nuclei, and the nature of the observed resonances were studied in the framework of potential scattering. In order to complement the existing experimental data, elastic scattering of alpha particles was studied for a series of nuclei from ^{23}Na through ^{28}Si. The data were analyzed by means of an angular momentum-dependent optical model. (tr-BE)

22667 ALPHA-CLUSTER STRUCTURE IN NEON REGION. Hiura, J. (Iwate Univ., Morioka, Japan); Nemoto, F.; Bando, H. Progr. Theor. Phys. (Kyoto), Suppl.; No. 52, 173-227(Aug 1973).

The nuclei in the Ne region are situated in the critical region where transition is proceeding from the shell phase to the molecular phase. The viewpoint of the critical region for neon has been obtained first through the recognition of the applicability of the alpha-cluster plus ^{16}O-core model as well as the customary shell model, and then more detailed studies of observed characteristics from the molecular point of view. The first half of this paper presents the pioneering work on ^{20}Ne and neighbouring nuclei by adopting the alpha-cluster plus ^{16}O-core model, with the aim of examining in this region the molecular viewpoint that was confirmed in the Be region. The ground $K^{\pi} = 0^+$ rotational band of ^{20}Ne was successfully explained with an effective potential with a repulsive core and state-dependent attractive well, and also the weak coupling scheme in ^{19}F and the strong coupling scheme in ^{21}Ne were explained in terms of the particular state dependence of the effective nucleon–alpha interaction and the effect of the Pauli principle. The latter half of this paper is devoted to the presentation of the work to clarify the mechanism of the growth and disappearance of molecular aspects. The microscopic alpha-cluster plus core model was proposed, which includes both the overall antisymmetrization and alpha clustering characterizing the shell model aspects and the molecular aspects. This model clarifies the physical origin of weak alpha-hole coupling scheme and the mechanism of gradual growth of the alpha-core aspects (alpha-characterization) from ^{20}Ne to ^{16}O, by noticing the competition and interplay of the alpha-clustering and overall exchange effect. (JA)

22668 ANTICENTRIFUGAL STRETCHING IN ^{20}Ne. Mosley, C. A. Jr.; Fortune, H. T. (Univ. of Pennsylvania, Philadelphia). Phys. Rev., C; 9: No. 2, 775-776(Feb 1974).

The anticentrifugal stretching in ^{20}Ne resulting from a Hartree–Fock calculation is well accounted for in an α-^{16}O cluster model with a Woods–Saxon potential that has the same radius for states of different J. (auth)

22669 LIFETIMES OF LEVELS IN ^{24}Ne. Watson, B. A.; Becker, J. A.; Fisher, T. R. (Lockheed Palo Alto Research Lab., CA). Phys. Rev., C; 9: No. 3, 1200-1201(Mar 1974).

Nuclear lifetimes of levels in ^{24}Ne were measured by employing the ^{22}Ne(t,p) reaction at a triton bombarding energy of 2.9 MeV. Protons were detected by an annular silicon surface-barrier detector at an average angle of 174°, and coincident γ rays were detected by a Ge(Li) detector positioned at angles of 30 and 120°. Nuclear lifetimes were extracted by the Doppler-shift-attenuation technique. Measured lifetimes of the 1.98-, 3.87-, and 4.76-MeV levels were $0.89^{+0.09}_{-0.09}$, <0.18, and $3.3^{+0.4}_{-0.4}$ ps. The experimental results are well reproduced by the shell-model calculations of Robertson and Wildenthal [Phys. Rev., C; 8: 241(1973)]. (1 table) (auth)

22670 ^{20}Ne(α,2α)^{16}O REACTION AT 78.6 MeV. Epstein, M. B. (California State Univ., Los Angeles); Margaziotis, D. J.; King, N. S. P.; Cahill, T. A. Phys. Rev., C; 9: No. 2, 581-588(Feb 1974).

The ^{20}Ne(α,2α)^{16}O reaction has been measured at symmetric and asymmetric sets of angles at E_α = 78.6 MeV. The data indicate that quasifree $\alpha-\alpha$ scattering and, consequently, α clustering plays a dominant role for pairs of angles favoring quasifree scattering. The data have been compared with the plane-wave impulse approximation using a radial cutoff. This calculation does not give a good fit to data for non-quasifree angles. The reaction goes predominantly to the ^{16}O ground state with a small yield to the 6.92–7.12-MeV doublet in ^{16}O. (auth)

22671 STUDY OF THE EXCITED STATES OF ^{26}Mg BELOW 11 MeV BY INELASTIC ELECTRON SCATTERING. Lees, E. W.; Johnston, A.; Brain, S. W.; Curran, C. S. (Glasgow Univ.). J. Phys., A (London); 7: No. 8, 936-974(21 May 1974).

The excited states of ^{26}Mg below 11 MeV excitation energy were studied by inelastic electron scattering in the momentum transfer range 0.4 to 1.05 fm^{-1}. At lower excitation energies, several spin–parity uncertainties were resolved and the spin–parity assignments were extended up to 11 MeV. Ground-state reduced transition probabilities and transition radii were measured for 29 levels. The reduced transition probabilities were found to be more accurate than existing experimental results. The form factors and transition probabilities are compared to various theoretical predictions. (auth)

22672 STUDY OF ^{24}Mg BY INELASTIC ELECTRON SCATTERING. Johnston, A.; Drake, T. E. (Glasgow Univ.). J. Phys., A (London); 7: No. 8, 898-935(21 May 1974).

The excited states of ^{24}Mg with excitation energies less than 14.0 MeV were studied by inelastic electron scattering in the momentum transfer range 0.4 to 1.14 fm^{-1}. Ground state transition probabilities and transition radii were deduced for 9 known levels with excitation less than 11 MeV, and evidence was obtained for a (2^+, 4^+) doublet at 10.352±0.024 MeV. In the excitation energy region 11.0 to 14.0 MeV three E2 and four E3 transitions were observed and their ground state widths were deduced. The known 2^- states at 12.67 MeV and 13.37 MeV were found to have ground state widths of $(1.4 \pm 0.5) \times 10^{-2}$ eV and $(4.0 \pm 1.4) \times 10^{-3}$ eV, respectively. The form factors obtained for the low-lying states were compared with the predictions of the classical alpha particle model, the Nilsson model and Hartree–Fock calculations. Comparisons were also made with the single-particle shell model predictions for the states at 9.97, 10.70, 12.67 and 13.37 MeV. (auth)

22673 STATUS OF NUCLEAR COEXISTENCE FOR ^{32}S. Cheng, Y. T.; Goswami, A.; Throop, M. J.; McDaniels, D. K. (Univ. of Oregon, Eugene). Phys. Rev., C; 9: No. 3, 1192-1195 (Mar 1974).

The mean lifetime of the 0^+ state at 3.778 MeV in ^{32}S was carefully remeasured by the Doppler-shift-attenuation method, by means of the reaction ^{31}P(p,γ)^{32}S. This lifetime was combined with other information to obtain a good experimental value for the admixture of the deformed and spherical states in ^{32}S; the validity of the coexistence picture for this nucleus was thereby confirmed. (auth)

22674 γ DECAY OF THE RESONANT STATES FROM THE REACTION ^{34}S(p,γ)^{35}Cl. Il'enko, L. V.; Rudak, E. A. (Inst. of Physics, Minsk). Yadern. Fiz.; 19: No. 6, 1181-1184(Jun 1974). (In Russian).

The mechanism of the radiative capture of 0.7 to 2.4 MeV protons by ^{34}S nuclei is studied. The absolute values of the coefficients in the expansion of the resonance wave functions in the basis functions of the phonon plus particle type are estimated. (auth)

22675 QUADRUPOLE MOMENTS OF ^{35,37}Cl IN THE OVERLAP REPRESENTATION. Clement, C. F. (United Kingdom Atomic Energy Authority, Harwell, Eng.); Perez, S. M. J. Phys., A (London); 7: No. 8, L93-L96(21 May 1974).

For ^{37}Cl there is close agreement between the quadrupole moment measured by atomic methods and that deduced from proton pick-up spectroscopic factors, but there is probably some discrepancy in the case of ^{35}Cl, where the pick-up data are more ambiguous. The agreement casts doubt on the use of "effective charges" for these nuclei. (auth)

22676 LIFETIMES OF $\frac{1}{2}^-$ STATES IN ^{35}Cl, ^{37}Cl, AND ^{39}K. Hutcheon, D. A.; White, D. C. S.; McDonald, W. J.; Neilson, G. C. (Univ. of Alberta, Edmonton). Can. J. Phys.; 52: No. 12, 1090-1095(15 Jun 1974).

Nuclear excited state lifetimes have been determined by direct timing, by using a pulsed beam and a Ge(Li) detector in singles. Results are as follows: ^{35}Cl (3163 keV), 46 ± 6 ps; ^{37}Cl (3103 keV), 16 ± 9 ps; ^{39}K (2813 keV), 71 ± 5 ps; ^{39}K (3598 keV), 91 ± 27 ps. M2 and E3 transition strengths of the transitions in ^{35}Cl and ^{37}Cl are compared with previous theoretical calculations. (auth)

22677 INVESTIGATION OF ODD PARITY STATES IN ^{32}S. Grawe, H.; Cairns, J. E.; Greene, M. W.; Kuehner, J. A. (McMaster Univ., Hamilton, Ont.). Can. J. Phys.; 52: No. 11, 950-958 (1 Jun 1974).

States in ^{32}S have been populated using the ^{31}P(p,γ) reaction at the E_p = 895, 1438, and 1583 keV resonances. Angular distributions, a linear polarization measurement, and the results from the ^{32}S(α,α') reaction at 180° yielded the following spin and/or parity assignments for bound levels J^π(6.62) = 4^-, J^π(6.76) = 3^-, 4^+, 5^-, J^π(6.85) = 3^-, 4^+, and J^π(7.95) = 3, 4, 5^-, and for resonance

states J(10.26) = 4 and J(10.40) = 4. The γ decay of selected excited states has been studied, and mixing ratios were obtained for the strongest branches. Doppler shift measurements yielded lifetimes of 810 (−250, +350) fs, >300 fs and 110 (−40, +60) fs for the states at 6.62, 6.76, and 7.95 MeV, respectively. The results are discussed and compared with shell model predictions. (auth)

22678 ANGULAR DISTRIBUTION OF PHOTONUCLEONS IN THE PHOTOSPLITTING REACTION OF ^{40}Ca IN THE GIANT RESONANCE REGION. Kabachnik, N. M.; Razuvaev, V. N. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 15: No. 1, 112-113 (1974). (In Russian).

An expression is given for the differential cross section of (gamma, p) and (gamma, n) reaction in terms of the total cross section of the corresponding partial reaction and of E-1 and E-2 absorption. Values of the total cross section and coefficients of other nuclear interactions are determined by matrix elements of multipole operators describing the interaction of the nucleus with the electromagnetic field. These matrix elements were calculated within the framework of the particle-hole resonance model. For the ^{40}Ca (gamma, p) ^{39}K reaction the calculations show that the coefficient in the anisotropy of the angular distribution is almost a constant in the region of the main maxima of the giant resonance but varies strongly between the resonances. A general tendency to an increase in anisotropy is noticed with increasing nucleon energy. An asymmetry with respect to 90° which is determined by interferences of dipole and quadrupole transitions is observed at definite excitation energies of the nucleus. A detailed comparison of calculated and experimental results was not possible because of the insufficient accuracy of the experimental results. (SJR)

22679 SHAPE MIXING AS AN APPROXIMATION TO SHELL MODEL ^{24}Ne. Khadkikar, S. B.; Kulkarni, D. R.; Pandya, S. P. (Physical Research Lab., Ahmedabad, India). Pramana; 2: No. 5, 259-268(May 1974).

Band-mixing calculations were done for ^{24}Ne including the two degenerate prolate and oblate Hartree-Fock states and also some particle-hole excited states in the projection formalism using an interaction obtained by Preedom and Wildenthal. The energy spectrum agrees very well with the experimental results as well as the exact shell-model calculations. Thus, the band-mixing calculations provide a good approximation to the lengthy exact shell-model calculations. In addition, they offer a physical insight into the collective nature of the nucleus as nuclear states are described in terms of only a few "intrinsic" states. (2 figures, 6 tables) (auth)

Nuclear Properties and Reactions, 39 ≤ A ≤ 58

Refer also to abstracts 22584, 22617, 22626, 22650, 22652, 22655, 22660, 22662, 22676, 22715, 22726, 22749, 22793, and 22824.

22680 (AECL-4773, pp 15-18) FERMI BETA DECAY, A > 40: THE MASSES OF ^{42}Sc, ^{46}V, ^{50}Mn, AND ^{54}Co. Hardy, J. C.; Ball, G. C.; Geiger, J. S.; Graham, R. L.; Macdonald, J. A.; Schmeing, H. May 1974.

22681 (IKF-32, pp 15-17) STUDIES ON THE STRUCTURE OF THE MIRROR NUCLEI ^{39}K AND ^{39}Ca. Bass, R.; Kessel, W.; Lorz, H.; Weber, T. 1973. (In German).

22682 (INIS-MF-1168-1, pp vp, 18p) DENSITY DEPENDENT FORCES. Zamick, L. 1973.

From Finnish summer school in nuclear physics; Liperi, Finland (11 June 1973).

The discussion of density-dependent forces covers the delta interaction, the giant dipole in lead-208, oxygen-16, and the deuteron, density, simple density-dependent interactions, nuclear compressibility, breathing mode energy, rearrangement energy, three-body force of Skyrme, and calcium 40 structure. (JFP)

22683 (IPNO-T-74-3) SELECTIVITY OF THE (d,α) REACTION AT 80 MeV. Study of the ^{38}K, ^{42}K, ^{46}K, ^{56}Co Nuclei. Frascaria, N. (Paris-11 Univ., 91-Orsay (France)). Jan 1974. 80p. (In French). Dep. NTIS $7.00.

Thesis.

The (d,α) reactions on ^{40}Ca, ^{44}Ca, ^{48}Ca and ^{58}Ni were studied using 80-MeV the incident deuteron beam of the Orsay synchrocyclotron. It was found that satisfactory D.W.B.A. fits can be obtained: experimental angular distributions are structured and provide minimal ambiguity in the determination of the angular momentum transfer. The good angular momentum matching requires large values for angular momentum transfer. Together with the well documented selectivity of the (d,α) reactions, it allows identification of 7^+ and 3^+ states in ^{38}K, ^{42}K, ^{46}K and ^{56}Co. The observation of 7^+ levels in ^{38}K, ^{42}K, ^{46}K gives a measure of the $f_{\frac{7}{2}}$ proton occupation number in the ground state of the target nuclei ^{40}Ca, ^{44}Ca, ^{48}Ca. The presence of 3^+ states at high excitation energy allows the localization of $d_{\frac{3}{2}}$ shell in ^{46}K and ^{56}Co. Low lying ^{56}Co levels can be described as one particle-one hole and two particle-two hole. States of this type were calculated by McGrory up to 5 MeV excitation, and the agreement with experiment is quite good. (auth)

22684 (KHFTI-73-9, pp 70-71) INELASTIC ELECTROMAGNETIC FORM FACTORS ^{39}K AND ^{40}Ca NUCLEI IN THE RANGE OF MAXIMUM OF QUASIELASTIC CONTINUUM. Vlasenko, V. G.; Afanas'ev, N. G.; Gol'dshtein, V. A.; Dementii, S. V.; Kuplennikov, E. L.; Ogurtsov, V. I.; Startsev, V. I. (Physical-Technical Inst., Kharkov). 1973. (In Russian).

The cross section of the quasielastic scattering of electrons at 550 to 1150 MeV was measured at scattering angles of 15 to 60° for ^{39}K and ^{40}Ca. On the basis of the measurements the form factors were determined. The experimental values of the form factors were compared with the values calculated in the shell model with one-particle wave function of the oscillator potential with and without consideration of the Pauli principle. (tr-auth)

22685 (NP-20044, pp 22-26) FINITE RANGE DWBA ANALYSES OF THE REACTIONS ^{52}Cr(^{14}N,^{13}C)^{53}Mn AND ^{52}Cr(^{12}C,^{11}B)^{53}Mn. Nakajima, S. Dec 1973.

22686 (NP-20044, pp 27-31) ANGULAR DISTRIBUTIONS OF TRANSFER REACTIONS INDUCED BY HEAVY IONS. Yoshie, M.; Katori, K.; Kohno, I.; Nakajima, S.; Motobayashi, T.; Mikumo, T.; Kamitsubo, H. Dec 1973.

22687 (NP-20044, pp 42-45) (^{3}He,d) REACTIONS ON Cr ISOTOPES AT AN ENERGY OF 29.3 MeV. Nakanishi, N.; Takeda, S.; Ohnuma, H.; Yamada, S.; Sakaguchi, H.; Nakamura, M.; Takeuchi, S.; Koyama, K. Dec 1973.

22688 (ZfK-262, pp 10-13) EXCITATION OF THE $g_{\frac{9}{2}}$ ISOBARIC ANALOG RESONANCE IN ^{53}Mn. Beckert, K.; Gersch, H. U.; Grambole, D.; Herrmann, F.; Kleinwaechter, P.; Schneidereit, C.; Schobbert, H.; Thomas, H. J. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Sep 1973. (In German).

22689 (ZfK-262, pp 25-27) ABSOLUTE NONEQUILIBRIUM AND EQUILIBRIUM ANALYSES OF NEUTRON EMISSION SPECTRA IN A BROAD MASS NUMBER REGION. Hermsdorf, D. (Technische Univ., Dresden); Sassonoff, S.; Seeliger, D.; Seidel, K.; Toneev, W. D. Sep 1973. (In German).

22690 (ZfK-262, pp 31-33) STUDY OF THE REACTION MECHANISM FOR INELASTIC SCATTERING OF 3.2-MeV NEUTRONS BY ^{52}Cr. Hoehn, J.; Kiessig, G. (Technische Univ., Dresden). Sep 1973. (In German).

22691 TOTAL AVERAGE CROSS SECTION FOR THE REACTIONS ^{58}Ni(n,np)^{57}Co, ^{58}Ni(n,pn)^{57}Co AND ^{58}Ni(n,d)^{57}Co IN A FISSION-TYPE REACTOR SPECTRUM. Bruggerman, A.; Maenhaut, W.; Hoste, J. (State Univ., Ghent). Radiochem. Radioanal. Lett.; 18: No. 2, 87-98(15 Jul 1974).

The total average cross section $\bar{\sigma}_\gamma$ for reactions ^{58}Ni(n,np)^{57}Co, ^{58}Ni(n,pn)^{57}Co and ^{58}Ni(n,d)^{57}Co in a fission neutron spectrum was experimentally determined by irradiation of nickel disks in a fission-type reactor spectrum, followed by measurement of the induced ^{57}Co activity with a Ge(Li) detector of calibrated detection efficiency. The equivalent fission flux was determined via the ^{27}Al(n,α)^{24}Na reaction with $\bar{\sigma}_\gamma$ = 0.64 mb. Gamma-ray attenuation in the sample was taken into account, and corrections were carried out for the interference ^{58}Ni(n,2n)^{57}Ni $\xrightarrow{\beta^+}$ ^{57}Co. A value of 0.216 ± 0.005 mb was found. (1 figure, 3 tables) (auth)

22692 HIGH-RESOLUTION COMPARISON OF (p,p′) AND (d,d′) REACTIONS. Cohen, B. L.; Holden, J. E.; Rao, G. R. (Univ. of Pittsburgh). Phys. Rev., C; 9: No. 3, 1025-1032(Mar 1974).

A comparison is made between the strengths with which each nuclear state up to 5.3 MeV excitation in ^{124}Sn, 7.3 MeV in ^{64}Ni, and 7.6 MeV in ^{58}Ni is excited in (p,p′) and (d,d′) reactions. A very strong correlation is found, indicating that direct-reaction processes are dominant in both reactions. The fraction of these direct reactions resulting in excitation of the lowest energy 2^+ and 3^- collective states is determined and in each case is less than 20%. (auth)

22693 STATISTICAL MODEL ANALYSIS OF GAMMA RAY ANGULAR DISTRIBUTIONS FOLLOWING THE ^{49}Ti(p,p′)^{49}Ti RE-

ACTION AT E_p = 5.0 MeV. Bardin, T. T.; Becker, J. A.; Fisher, T. R. (Lockheed Palo Alto Research Lab., CA). Phys. Rev., C; 9: No. 2, 790-792(Feb 1974).

Angular distributions of several γ-ray transitions following the reaction $^{49}Ti(p,p')^{49}Ti$ were measured at E_p = 5.0 MeV. The γ radiation was detected in a 37-cm³ Ge(Li) counter at angles θ_γ between 0 and 90° to the incident beam direction. Relative cross sections and γ-ray angular distributions were compared with predictions of the compound-nucleus model for the transitions 2.29 → 0.98, 2.42 → 0, 2.42 → 0.98, 3.22 → 0.98, 3.22 → 2.29, 3.36 → 0.98, and 3.37 → 0.98. Reasonable agreement was found, except in the case of the 2.42-MeV level. (auth)

22694 ISOBARIC ANALOG STATE OF THE 0.211 MeV LEVEL OF ^{56}Mn IN ^{56}Fe. El-Kazzaz, S. A.; Abdel-Harith, M.; El-Nadi, L. M.; Megalea, W. Z. (Atomic Energy Establishment, Cairo). Ann. Phys. (Leipzig); 29: No. 3, 251-258(Sep 1973).

The gamma-ray spectrum from the reaction $^{55}Mn(p,\gamma)^{56}Fe$ was measured at the isobaric analog resonance at E_p = 1537 ± 4 keV with a 15-cm³ Ge(Li) detector. Double and triple angular correlations at this resonance state were measured. Proton elastic scattering was also studied at this resonance at the angles 135° and 150°. Analysis of these data yields a spin and parity assignment 2^+, proton radiative width 2 ± 0.2 keV, and total width 9 keV to this resonance state, which is the isobaric analog of the third excited state of ^{56}Mn at an excitation energy of 0.211 MeV. (3 figures, 1 table) (auth)

22695 $^{40}Ca(d,p)^{41}Ca$ REACTIONS, THE STATISTICAL MODEL, AND THE DISTORTED WAVE BORN APPROXIMATION. Saunders, W. E. Edmonton, Alberta; Univ. of Alberta (1971). 70p.

Thesis.

Yield curves for $^{40}Ca(d,a)$ reactions have been measured in the range 4.50 to 5.50 MeV. $^{40}Ca(d,p)$ yield curves were obtained from 4.88 to 5.50 MeV; both sets of data were taken in 20 keV energy steps. The yield curves were analyzed for Ericson fluctuations giving the average width of a level in the compound nucleus ^{42}Sc at ~15 MeV excitation. It was found to be Γ ≤ 23 keV. Angular distributions for several $^{40}Ca(d,p)^{41}Ca$ reactions have been measured in the range 4.50 to 5.50 MeV in 2 keV steps. These data were averaged over energy intervals of ≥10 Γ, ≥20 Γ and ≥40 Γ. The resulting energy averaged angular distributions were then compared with either DWBA or statistical model cross section predictions. It was found that the two smaller averaging intervals are inadequate. Even an averaging interval of ≥40 Γ is only partially successful in removing energy dependent cross section fluctuations, permitting comparison with theory and the extraction of spectroscopic factors. (auth)

22696 NUCLEAR STRUCTURE STUDIES IN ^{53}Mn VIA THE $^{53}Cr(p,n\gamma)^{53}Mn$ REACTION. Chung, W. H. Edmonton, Alberta; Univ. of Alberta (1972). 166p.

Thesis.

The properties of the low-lying excited states in ^{53}Mn were studied by measuring gamma-ray angular distributions and lifetimes using the $^{53}Cr(p,n\gamma)^{53}Mn$ reaction. Energy levels of ^{53}Mn have been found. The measurement of gamma-ray angular distributions and yield curves together with predictions based on the compound nuclear statistical model have enabled new spin assignments to be made. Multipole mixing ratios and branching ratios were determined for some of the observed transitions. Lifetimes of nine excited states in ^{53}Mn have been measured using the Doppler-shift attenuation method. The reduced transition probabilities, B(M1) and B(E2), derived from the measured lifetimes are compared with intermediate-coupling model predictions. Agreement between theory and experiment is very good. The Nilsson model was used to predict energy levels of ^{53}Mn without considering band mixing. The results were compared with the experimental levels and the predictions with band mixing of Malik and Scholz. With and without band mixing, the theoretical fit to experimental results is fair only for a few low-lying levels. The properties of the low-lying excited states of ^{51}V and ^{53}Mn were investigated using the intermediate-coupling unified nuclear model. Energy levels and electromagnetic properties were calculated. In general, the results are in good agreement with experimentally observed values for the low-lying excited states. The experimental results are also compared with available shell model calculations. (CA)

22697 GAMOW-STATE ANALYSIS OF $^{54}Fe(d,n)$ TO PROTON RESONANCES IN ^{55}Co. Coker, W. R. (Univ. of Texas, Austin). Phys. Rev., C; 9: No. 2, 784-786(Feb 1974).

Distorted-wave Born-approximation (DWBA) calculations are performed for $^{54}Fe(d,n)$ angular distributions at 10 MeV populating five proton resonances in ^{55}Co, at 5.17, 5.54, 5.74, 5.86, and 6.07 MeV excitation, using Gamow states as form factors. Results of the calculations are compared with previous DWBA analyses in which bound-state functions were used. (auth)

22698 β-DECAY OF ^{41}Cl. Gurach, Kh.; Kabachenko, A. P.; Kuznetsov, I. V.; Tarantin, N. I. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 19: No. 6, 1167-1171 (Jun 1974). (In Russian).

The β-decay of ^{41}Cl is investigated by means of the mass separator of EMSONHIB on line with the heavy ion cyclotron. The ^{41}Cl isotope was produced in the three-nucleon transfer reaction ^{181}Ta (^{40}Ar, ^{41}Cl). Maximal energy of the beta particles and the total energy of the beta decay are measured and found to be 3.80 ± 0.45 MeV and 5.67 ± 0.16 MeV, respectively. The decay half life time is 34 ± 3 sec. The decay scheme of ^{41}Cl is presented. (auth)

22699 INTERFERENCE OF COULOMB AND NUCLEAR EXCITATIONS IN THE INELASTIC SCATTERING OF ^{3}He, ^{6}Li, AND ^{12}C IONS ON THE ^{58}Ni NUCLEUS. Glukhov, Yu. A.; Man'ko, V. I.; Novatskii, B. G.; Oglobiin, A. A.; Sakuta, S. B.; Stepanov, D. N.; Chuev, V. I. (Inst. of Atomic Energy, Moscow). Yadern. Fiz.; 19: No. 6, 1207-1211(Jun 1974). (In Russian).

The 11.5 MeV ^{3}He ions, the 22.8 MeV ions of ^{6}Li and ^{12}C ions with 46 MeV energy were scattered at ^{58}Ni, with excitation of the 1.45 MeV (2^+) collective state. All angular distributions show a characteristic feature in the angular range corresponding to the surface collisions. The effect is due to the interference of the nuclear and Coulomb excitations. It is found that the interference patterns for the given ions are essentially different that results in a strong difference between the surface interactions of the ^{3}He, ^{6}Li, and ^{12}C ions. (auth)

22700 RADIATIVE PROTON CAPTURE BY NUCLEI ^{50}Cr, ^{52}Cr, AND ^{54}Cr. Nemashkalo, B. A.; Ekhichev, D. I.; Klyucharev, A. P.; Krivonosov, G. A.; Popov, A. I.; Storizhko, V. E.; Chirt, V. K. (Physical-Technical Inst., Kharkov). Yadern. Fiz.; 19: No. 6, 1185-1189(Jun 1974). (In Russian).

Triple angular γγ correlations in reaction of the radiative proton capture by nuclei ^{54,52,50}Cr are measured on semithick targets. The data are analyzed in framework of the statistical theory. Spins of low lying states and the γ-transition mixing coefficients are determined for nuclei of manganese isotopes. (auth)

22701 ELECTROMAGNETIC PROPERTIES OF NUCLEI NEAR CLOSED SHELLS: RDM LIFETIMES AND E2 EFFECTIVE CHARGE SYSTEMATICS FOR 40 < A < 56; HIGH-SPIN ISOMERS IN THE MASS 90 REGION. Brown, B. A. Stony Brook, NY; State University of New York (1974). 245p. University Microfilms Order No. 74-14,796.

Thesis (Ph. D.).

Lifetimes for a number of levels in nuclei with 40 < A < 56 were measured by using the recoil-distance technique. Results were obtained for ^{47}Sc, ^{43}Sc, ^{49}V, ^{50}Cr, ^{51}Mn, ^{53}Mn, and ^{54}Fe. In addition, an improved value was obtained for 937-keV 3^+ level in ^{18}F. The B(E2) strengths for transitions in nuclei with 42 ≤ A ≤ 44 were collected and interpreted in terms of isospin-dependent effective charges by using wave functions for the $(1f_{\frac{7}{2}})^n$, $(fp)^n$ and $(fp)^{n+m}(sd)^{-m}$ model spaces. The core polarization charges obtained from an analysis using $(fp)^2$ + $(fp)^4(sd)^{-2}$ wave functions are e_p = 1.16 ± 0.16 and e_n = 0.45 ± 0.03. The B(E2) strengths for transitions in the isotones with 28 neutrons were also collected and interpreted by using $(1f_{\frac{7}{2}})^n$ wave functions. The effective proton charge was found to be approximately constant for all transitions with e_p = 1.8 to 2.0. Estimates of effective proton charges for these nuclei resulting from the use of larger model spaces were discussed. High-spin states in the mass-90 region were studied with reactions induced by 34-MeV ^{6}Li and ^{7}Li beams on targets of natural Sr and isotopically enriched ^{90}Zr. Results for mean lifetimes were obtained for ^{91}Nb, ^{91}Zr, and ^{93}Tc. The decay modes of these states were also obtained. In addition, the prompt decay modes of high-spin levels in ^{91}Nb and ^{91}Zr were measured. The results for the energy levels of ^{91}Nb, ^{93}Tc, and ^{91}Zr were compared with recent theoretical calculations. B(E2) strengths for high-spin transitions in the isotones with 50 neutrons were collected and discussed. Emphasis was placed on the effects of orbitals not included in the usual $\pi g_{\frac{9}{2}}\, \pi p_{\frac{1}{2}}\, \nu d_{\frac{5}{2}}$ model space. (RWR)

22702 $^{43}Ca(^{3}He,d)$ REACTION AND THE PARITY OF THE 425 keV STATE OF ^{44}Sc. Chapman, R.; Dracoulis, G. D. (Manchester Univ., Eng.). J. Phys., A (London); 7: No. 8, L97-L99 (21 May 1974).

The Harwell multi-angle magnetic spectrograph and tandem accelerator have been used to study the 425 keV state of ^{44}Sc populated in the $^{43}Ca(^{3}He,d)^{44}Sc$ reaction. Comparison of the measured angular distribution of the deuteron group populating the 425 keV state with predictions based on the distorted-wave Born approximation suggests that population of the state proceeds by l = 2 proton transfer. The consequent assignment of negative parity to

the 425 keV state removes an inconsistency which has existed within earlier particle transfer reaction studies of this state. (auth)

22703 MANY PARTICLE–MANY HOLE MODEL FOR POSITIVE PARITY STATES OF ^{40}Ca. Bhatia, K. L. Montreal; McGill University (1973). National Library of Canada, Ottawa.

Thesis (Ph. D.).

The positive-parity low-lying states of ^{40}Ca are investigated by considering them as admixtures of many-particle–many-hole configurations. It is shown that ^{44}Ti and ^{36}Ar can be described by a deformed axially symmetric HF method. The states belonging to the $\kappa = 0$ band of ^{44}Ti and of ^{36}Ar can be used in building up the 4p–4h basis of ^{40}Ca. The closed shell model core, $|0>$, filling all orbitals up to $d_{\frac{3}{2}}$ and $f_{\frac{5}{2}}^{8}d_{\frac{3}{2}}^{-2}$ $|0>$ are, respectively, the 0p–0h and 2p–2h configurations, included in the basis. The model reproduces the first $k = 0$ and $k = 2$ deformed bands of ^{40}Ca. The calculated B(E2) rates are compared with the available results. The calculation can reproduce all levels except 0^+(5.21 MeV), 2^+(5.63 MeV), and 4^+(6.54) which, it appears, require configurations outside this model space. (Diss. Abstr. Int., B)

22704 INELASTIC SCATTERING OF NEUTRONS WITH THE INITIAL ENERGY 9.1 ± 0.2 MeV AND THE DENSITY OF NUCLEAR LEVELS. Biryukov, N. S.; Zhuravlev, B. V.; Kornilov, N. V.; Plyaskin, V. I.; Rudenko, A. P.; Sal'nikov, O. A.; Trykova, V. I. Yadern. Fiz.; 19: No. 6, 1190–1200(Jun 1974). (In Russian).

The spectra of neutrons with initial energy 9.1 ± 0.2 MeV inelastically scattered on nuclei Fe, Co, Ni, Cu, Nb, Sn, and Bi were measured at 90°. The measurements were made in the cylindrical geometry by the time-of-flight method. The neutron spectra were observed in the energy interval 0.5–9.1 MeV. Comparing the data with theory the nuclear temperatures, the parameters of the density of nuclear levels in the Fermi gas model with phenomenological treatment of the pairing energy a and the parameters of the superfluid nuclear model g_Z, g_N, Δ_{0Z}, Δ_{0N} were obtained. (auth)

22705 POLARIZED ION SOURCE DEVELOPMENT AND THE LOWEST T = ½ LEVELS IN ^{41}Sc Trainor, T. A. Chapel Hill, NC; University of North Carolina (1973). 185p. University Microfilms Order No. 74-15,401.

Thesis (Ph. D.).

Two high-intensity duoplasmatron ion sources were constructed for the purpose of upgrading the performance of a Lamb-shift polarized ion source. Performances of the two sources, both on a test bench and on a Lamb-shift polarized source, were compared. Installation of the second duoplasmatron on the TUNL Lamb-shift source provided an increase in polarized beam intensity by a factor of 3 to 5. The quench-ratio method of determining beam polarization in a spin-filter-type polarized ion source was examined in detail. The result of this investigation was an establishment of the accuracy of the quench-ratio method to be 1 to 2% for proton and deuteron beams for the TUNL Lamb-shift source. This polarized source was used to locate the lowest T = ½ analog resonance in ^{41}Sc. The narrow width of this resonance indicates that the isospin quantum number, T, has greater purity in the light nuclei than has been previously believed. (Diss. Abstr. Int., B)

22706 UTILITY OF THE ^{13}C PROJECTILE IN MULTINUCLEON PICKUP REACTIONS. Anderson, R. E. Lafayette, IN; Purdue University (1973). 167p. University Microfilms Order No. 74-15,114.

Thesis (Ph. D.).

In order to study the utility of the ^{13}C projectile in multinucleon pickup studies, targets of isotopically enriched ^{54}Fe and ^{40}Ca were bombarded at several energies between 40 MeV and 48 MeV. Three reactions were found to display reasonably high cross sections. These were the one proton, two proton, and ^{3}He pickup reactions. The latter two reactions are of particular interest. This is because the only two proton pickup study which has been done previously furnished unsatisfactory results due to the strong population of excited states in the detected particle; in addition, ^{3}He pickup has never been observed before in a direct reaction. The study of the one proton pickup reaction is useful because of the comparison which may be made with traditional light ion reactions such as (d,^{3}He). The results of this work have shown that the dominant mechanism in the (^{13}C,^{14}N) reaction is that of direct capture of a target proton. The spectroscopic factors obtained in this work using the single step DWBA predictions agree with those obtained in light ion induced reactions. No evidence was found to indicate the multistep population of any levels in the residual nucleus. In addition, no excited states of the detected particle were populated with appreciable cross section. The spectra obtained in the two proton pickup reactions were quite clean and free from the obscuring presence of excited states of the detected particle. The cross sections observed were 50 μb/sr for the ^{54}Fe(^{13}C,^{15}O)^{52}Cr(G.S.) reaction and 260 μb/sr for the ^{40}Ca(^{13}C,^{15}O)^{38}Ar(G.S.) reaction. These values are reasonably high and show that, in spite of the momentum mismatch present, the ^{13}C projectile may be used at Tandem energies to study two proton correlations in nuclei ranging into the f-p shell. The data could not be fit by assuming a "diproton" transfer. On the other hand, calculations based on a correct form factor have been very encouraging, though more work is needed. The levels populated in the ^{3}He pickup reactions are found to be of single neutron hole character. Since no DWBA calculations are available for these reactions no firm conclusion may be reached about the reaction mechanism. It is hoped that this work and others may stimulate some theoretical work in this area. In conclusion, it has been shown that the ^{13}C projectile is a suitable tool for use in multinucleon pickup studies. (Diss. Abstr. Int., B)

Nuclear Properties and Reactions, 59 ≤ A ≤ 89

Refer also to abstracts 22243, 22584, 22622, 22633, 22650, 22652, 22689, 22692, 22704, 22749, and 22793.

22707 (BNL-tr-571) CAPTURE OF THERMAL NEUTRONS BY EVEN–EVEN NUCLEI WITH A = 60 TO 80. Murzin, A. V. Translated by S. J. Amoretty from Yadern. Fiz.; 18: No. 1, 24–28(1973). 12p. Dep. NTIS $4.00.

The probability of a random anticorrelation between the reduced neutron and radiation widths in ^{69}Zn, ^{71}Ge, ^{73}Ge, and ^{81}Se nuclei is considered. It is shown that the anticorrelations observed in these nuclei following thermal-neutron capture are nonrandom in nature. (3 figures) (auth)

22708 (CNEA-358) EXCITATION FUNCTIONS FOR THE REACTIONS ^{89}Y(d,2n)^{89}Zr, ^{89}Y(d,3n)^{88}Zr, ^{89}Y(d,t)^{88}Y, AND ^{89}Y(d,α)^{87m}Sr. La Gamma de Batistoni, A. M. G.; Nassif, S. J. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). Nov 1973. 10p. (In Spanish). INIS.

Excitation functions for reactions induced by deuterons on ^{89}Y were measured by the activation method up to 27.2 MeV deuteron energy. The observed reactions were: ^{89}Y(d,2n)^{89}Zr, ^{89}Y(d,3n)^{88}Zr, ^{89}Y(d,t)^{88}Y and ^{89}Y(d,α)^{87m}Sr, where (d,t) means (d,t), (d,p2n) or (d,dn). (auth)

22709 (IKF-32, pp 17-18) LEVEL AND DECAY SCHEME OF ^{87}Y. Nottrodt, H. P.; Rauch, F. 1973. (In German).

22710 (INIS-mf-1359) NUCLEAR SPECTROSCOPIC STUDIES OF LOW-LYING STATES IN ^{77}As. Gualda, J. M.; Saxena, R. N.; Zawislak, F. C. (Instituto de Energia Atomica, Sao Paulo (Brazil)). [nd]. 16p. INIS.

The technique of directional gamma–gamma angular correlation has been used to investigate the decay of ^{77}Ge to levels in ^{77}As. The coincidence measurements were performed using a 35 cm^3 Ge(Li) detector and a 7.6 × 7.6 cm NaI (Tl) detector. The results of nine measured correlations served to verify the spin assignments of the low energy levels and in addition yielded values for the multipole mixing ratios of the involved gamma transitions. We also make a comparative analysis of ^{77}As and ^{75}As nuclei; both isotopes have a very similar low energy level structure. (INIS)

22711 (KHFTI-73-9, pp 9-12) FORMATION OF ^{8}Li FRAGMENTS AT THE INTERACTION OF γ-QUANTA AT E_γ < 4.6 GeV WITH PHOTOEMULSION NUCLEI. Mameev, V. V. (Tomsk Polytechnic Inst., USSR); Filimonov, V. A.; Galstyan, D. A. 1973. (In Russian).

The results of the study of the formation cross section and the energy spectra of ^{8}Li fragments during irradiation of emulsion nuclei with bremsstrahlung at energies up to 4.6 GeV were reported. (tr-auth)

22712 (KHFTI-73-9, pp 77-79) ELASTIC ELECTRON SCATTERING ON THE ^{60}Ni, ^{64,66,68}Zn NUCLEI AND ELECTRO-EXCITATION OF E2 AND E3-TRANSITION OF THE ^{54,56,58}Fe, ^{62}Ni, AND ^{68}Zn NUCLEI. Litvinenko, A. S.; Shevchenko, N. G.; Afanas'ev, N. G.; Afanas'ev, V. D.; Buki, A. Yu.; Savitskii, G. A.; Khvastunov, V. M.; Khomich, A. A.; Chkalov, I. I. (Physical-Technical Inst., Kharkov). 1973. (In Russian).

The elastic scattering cross sections of electrons with incident energy of 825 MeV on ^{64,66,68}Zn were measured. The parameters of the distribution of the charge density and the mean square radius $\langle r^2 \rangle^{1/2}$ were determined. The inelastic scattering cross sections of electrons with incident energy of 225 MeV on ^{54,56,58}Fe,

^{62}Ni, and ^{68}Zn were also measured. The probabilities obtained for the transition for the 2^+ level in ^{56}Fe and the 2^+ and 3^- levels in ^{54,58}Fe, ^{62}Ni, and ^{68}Zn were compared with other studies. (tr-auth)

22713 (TUT-RR-71/4) LEVELS OF ^{83}Kr OBTAINED IN THE DECAY OF ^{83}Rb AND ^{83}Br. Vaeisaelae, S.; Graeffe, G.; Heinonen, J. (Tampere Univ. of Tech. (Finland). Dept. of Physics). Sep 1971. 19p. INIS.

The levels of ^{83}Kr have been studied from the decay of both ^{83}Rb and ^{83}Br by solid state detectors and coincidence techniques. Twelve γ-rays were observed in the decay of ^{83}Rb, and eight, in the decay of ^{83}Br. The conversion coefficients have been measured for the 9.36 keV and for the 32.2 keV transition. Decay schemes are presented and the possible spins and parities have been determined for the levels in ^{83}Kr based on the log ft values and γ transition rates. (auth)

22714 (USIP-73-11) g-FACTOR OF THE 1291.5-keV STATE IN ^{59}Co. Bargholtz, C.; Beshai, S.; Eriksson, L.; Froeberg, L. E.; Gidefeldt, L. (Stockholm Univ. (Sweden). Fysiska Institutionen). Sep 1973. 15p. Dep. NTIS (US Sales Only) $4.00.

The g-factor of the 1291.5 keV state in ^{59}Co has been determined by the IPAC method. A multichannel goniometer was used in the study of the perturbed angular correlation of the 142.5–1291.5 keV cascade. Four sources were used, ^{59}Fe : Fe, ^{59}Fe : Co, ^{59}Fe : Ni and ^{59}Fe : Cu. The g-factor was found to be 1.72(8) based on an analysis of the iron, nickel and copper data. The corresponding magnetic moment, $\mu = 2.58(12)\mu_N$, is compared with the prediction of a unified vibrational model. Neglecting the static electric quadrupole interaction between the ^{59}Co nucleus and its environment in cobalt metal, the magnetic hyperfine field experienced by ^{59}Co in cobalt was found to be −221(22) kG at room temperature. (auth)

22715 (ZfK-262, pp 13-15) MEASUREMENT OF $g_{\frac{9}{2}}$ AND THE $d_{\frac{5}{2}}$ ISOBARIC ANALOG RESONANCES IN ^{59}Cu. Beckert, K. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.); Gersch, H. U.; Herrmann, F.; Schobbert, H.; Fodor, I.; Szentpetery, I. Sep 1973. (In German).

22716 (ZfK-262, pp 17-19) MEASUREMENT OF THE EXCITATION FUNCTION OF THE REACTION ^{60}Ni(p,γ_0)^{61}Cu WITH A THICK FOIL. Koch, R. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Sep 1973. (In German).

22717 CUMULATIVE AND INDEPENDENT POPULATION OF INDIVIDUAL LEVELS VIA THE ^{58}Ni(α,pγ)^{61}Cu AND ^{58}Ni(α,2pγ)^{60}Ni COMPOUND-NUCLEUS REACTIONS: A CORRELATION BETWEEN LEVEL CROSS SECTIONS AND ANGULAR MOMENTA. Barker, J. H.; Sarantites, D. G. (Washington Univ., St. Louis). Phys. Rev., C; 9: No. 2, 607-623(Feb 1974).

The cross sections for the cumulative and independent population of 21 levels in ^{61}Cu and 7 levels in ^{60}Ni via the ^{58}Ni(α,pγ)^{61}Cu and ^{58}Ni(α,2pγ)^{60}Ni reactions at 19.67-MeV bombardment energy were carefully measured in pγ-coincidence experiments with the protons detected at 90 and 157° relative to the beam direction. Spectra of the coincident protons leading to each level via γ cascades as well as energy-integrated cross sections were obtained. The angular distributions for the protons above 3.26 MeV of center-of-mass energy were measured at seven laboratory angles between 25 and 168°. Larger anisotropies for the protons from the (α,2p) reaction were observed relative to the (α,p) reaction. Some of the levels in ^{60}Ni were found to have large anisotropies with the maxima at the backward angles. When the cross sections for the cumulative and the independent population of levels of given angular momentum in ^{61}Cu or ^{60}Ni are plotted as a function of the level energy, they are found to decrease rapidly with level energy. The cross sections for cumulative and independent population increase with angular momentum at least for levels with J^π values between $\frac{1}{2}^-$ and $11/2^-$. The variation of the level cross sections with level energy follows closely the predictions of the compound statistical model for both the (α,pγ) and (α,2pγ) reactions. The experimental cross-section distributions, cross sections for the formation of individual levels and total cross sections for the (α,p) and (α,2p) reactions are compared with detailed calculations based on the statistical theory for nuclear reactions, in which Fermi-gas-model level densities and shell-model combinatorial level densities are employed. The experimental level cross sections and proton evaporation spectra are very well reproduced with level spacing parameters a of 6.56, 7.63, and 5.8 MeV^{-1} for ^{61}Cu, ^{61}Zn, and ^{58}Ni, respectively. By comparison with experimental level cross sections the energy dependence of the spin cutoff parameter σ^2 and the yrast line were determined for ^{61}Cu. The B(E1), B(M1) and B(E2) values for transitions originating at 10 MeV of excitation in ^{61}Cu that reproduce the (α,pγ) and (α,2pγ) level cross sections were found to be 0.055, 0.085, and 9.5 Weisskopf units, respectively. (auth)

22718 MEAN LIFETIMES OF THE γ CASCADES IN THE ^{61}Cu CONTINUUM. Sarantites, D. G.; Barker, J. H.; Lu, N. H. (Washington Univ., St. Louis). Phys. Rev., C; 9: No. 2, 603-606(Feb 1974).

The reduction of the Doppler shift for several bound-state transitions in ^{61}Cu due to the intervening γ cascades from the continuum was measured, using the Doppler-shift-attenuation method in a p-γ coincidence arrangement that employed the ^{58}Ni(α,pγ)^{61}Cu reaction at 19.7 MeV. It is found that the mean lifetimes of cascades that begin at the most probable excitation energy of ~9.5 MeV in ^{61}Cu and populate the 2336.2-keV ($\frac{9}{2}^-$), 2611.8-keV ($\frac{9}{2}^-$), and 3015.6-keV ($11/2^-$) states are, respectively 0.29 ± 0.12, 0.19 ± 0.07, and 0.43 ± 0.14 ps. The mean lifetimes of the cascades feeding the above three states were found to increase with increasing total energy available for the cascades with an approximately linear dependence with slopes of 40 ± 22, 29 ± 12, and 69 ± 20 fs/MeV. These results are consistent with an increase in the γ multiplicity in the cascades with increasing total available cascade energy. (auth)

22719 ISOMERIC RATIOS IN ^{69}Zn, ^{80}Br, ^{81}Se, AND ^{165}Dy. Gill, D. R. Ottawa; Carleton Univ. (1971). 101p.

Thesis.

Isomeric state production ratios in ^{69}Zn, ^{80}Br, ^{81}Se, and ^{165}Dy have been measured for the (n,γ) reaction as a function of neutron energy. A new gamma-ray cascade model for predicting these isomeric ratios has been devised, and its results have been compared with those of other models. This new model employed nuclear level densities generated numerically. The gamma-ray transition probabilities were estimated from Moszkowski's formulae. The initial spin distribution of the compound nucleus was calculated using optical model transmission coefficients. The measured isomeric ratios were found to be in accord with the expectation that as the neutron energy increased the production of the high spin state would increase. However, the calculations made with the cascade model did not agree completely with these measurements. It was concluded that, while the optical model transmission coefficients, the level densities, and the transition probability estimates of Moszkowski might be singularly or in combination at fault for this disagreement, the use of level densities in place of experimentally determined low-lying levels could be of greater importance. It was concluded that despite its present shortcomings the new cascade model, because it is parameter free, produced results which were more easily related conceptually to the forces and other properties of the nuclei that were studied. (CA)

22720 MASS AND DECAY PROPERTIES OF NUCLEI WITH RESPECT TO BETA STABILITY. Roeckl, E. (Gesellschaft fuer Schwerionenforschung mbH, Darmstadt, Ger.). pp 371-375 of Physik 1973. Weinheim, Ger.; Physik Verlag GmbH (1973). (In German).

From 37th physicists conference; Hamburg, F. R. Germany (24 Sep 1973). See CONF-730993-.

Experimental studies on the neutron-poor Kr and Rb isotopes and the neutron-rich Li, Na, and Rb isotopes are briefly reported. The half lives of the Kr and Rb neutron-poor isotopes can be explained within the framework of the beta strength function theory. The half lives and the P_n values of the neutron-rich Rb isotopes and the half lives and mass excess of the neutron-rich Li and Na isotopes are tabulated. (JSR)

22721 STUDY OF THE Ge(p,d) AND (p,t) REACTIONS, AND THE ^{26}Mg(p,t)^{24}Mg REACTION. Fournier, R. Ottawa; Univ. of Ottawa (1971). 173p.

A systematic study of the (p,d) and (p,t) reactions on all the stable germanium isotopes was made using a 20 MeV proton beam. Level energies in the residual nuclei are deduced and compared to previously measured values. Spin and parity assignments to these levels are suggested where possible. The experimental (p,d) angular distributions are compared to the DWBA theory, and absolute spectroscopic factors are extracted. From these, the occupation and center-of-gravity energy of the $2p_{\frac{3}{2}}$, $1f_{\frac{5}{2}}$, $2p_{\frac{1}{2}}$, and $1g_{\frac{9}{2}}$ shells are calculated and compared to results obtained for neighboring nuclei and to the predictions of the simple pairing theory. A collective model based on the Nilsson deformed potential to which is added a residual interaction of the pairing type is applied to try to predict the low-lying level properties of the odd germanium isotopes. The ^{26}Mg(p,t)^{24}Mg reaction was studied with a 20 MeV proton beam. A formalism is presented to calculate the structure amplitudes for the DWBA calculation. DWBA predictions are compared to the experimental angular distributions, and it is concluded that the large discrepancy between the two for the transition strength to the excited members of the ground-state rotational band in ^{24}Mg is due to the two-step process. (CA)

22722 MEASUREMENT OF MASSES OF STABLE ISOTOPES OF Co, Ni, AND Cu. Demirkhanov, R. A.; Dzkuya, M. L; Dorokhov, V. V.; Dorokhova, G. A. Yadern. Fiz.; 19: No. 6, 1161-1166(Jun 1974). (In Russian).

The mass spectrographic method is used to measure the masses of all stable isotopes of cobalt, nickel and copper. The measurements were made by means of the doublet method. Organic substances of various compositions were used as etalons. The mass of each isotope was measured by means of four-eight doublets of different composition and nature. The consistence of the data was controlled by "isotopic" doublets. There were 48 principle doublets measured, and the masses of eight isotopes in the region under consideration determined. The relative accuracy of the measurements is $\Delta M/M \simeq 2 \cdot 10^{-7}$. (auth)

22723 CROSS SECTIONS IN THE $^{59}Co(n,n'\gamma)^{59}Co$ REACTIONS. Le Claire, R. V. Lowell, MA; Lowell Tech. Inst. (1974). 168p. University Microfilms Order No. 74-14,913.

Thesis (Ph. D.).

The $^{59}Co(n,n'\gamma)^{59}Co$ reaction was employed to obtain neutron inelastic-scattering cross sections for eighteen levels in ^{59}Co in the incident neutron energy range 1.11 to 3.32 MeV. These cross sections were deduced from the measured gamma-ray production cross sections for twenty-seven gamma rays observed in the decay of the ^{59}Co nucleus by using a 40-cm^3 Ge(Li) detector. Pulsed-beam and time-of-flight techniques were employed for background reduction. Corrections were applied to the data which took into account Ge(Li) detector efficiency, finite sample size, neutron multiple scattering, and neutron and gamma-ray attenuation effects. Gamma-ray angular distributions were obtained at five incident neutron energies between 1.41 and 2.82 MeV. Hauser-Feshbach cross sections were calculated for the eighteen levels and J^π values assigned to several of these levels on the basis of comparisons between experimental and theoretical cross sections. (Diss. Abstr. Int., B)

22724 GENERATION OF ^8Be NUCLEI BY BREMSSTRAHLUNG γ QUANTA WITH 1.5, 2.0, AND 3.0 GeV ENERGY. Galstyan, J. A.; Zverev, A. M. Yadern. Fiz.; 19: No. 6, 1177-1180(Jun 1974). (In Russian).

The generation of the $^8Be_4$ nuclei in photonuclear reactions is considered for the 1.5, 2.0 and 3.0 GeV bremsstrahlung γ quanta. The ratio of the yields of the $^8Be_4$ nuclei to the number of photostars is $\simeq 2.3 \cdot 10^{-2}$, similar to hadronic experiments. (auth)

22725 EXCITATION FUNCTIONS AND ISOMERIC YIELD RATIOS OF (p,xn) REACTIONS INDUCED IN ^{75}As AND ^{115}In BY 20- TO 85-MeV PROTONS. Brodovitch, J. C. Montreal; McGill University (1973). National Library of Canada, Ottawa.

Thesis (Ph. D.).

Excitation functions for the reactions $^{75}As(p,n)^{75}Se$, $^{75}As(p,3n)^{73}Se$, and $^{115}In(p,3n)^{113}Sn$ induced by protons of energy 20 to 85 MeV were measured by radiochemical methods. The results were analyzed in terms of the statistical theory of nuclear reactions. Calculations were performed to reproduce the experimental excitation functions by using Monte Carlo techniques. The results were interpreted in terms of relative contributions of the compound-nucleus and direct-interaction mechanisms. The isomeric yield ratios of $^{73}Se^{m,g}$ and $^{113}Sn^{m,g}$ were also obtained. The results were compared with calculations following the Vandenbosch-Huizenga formalism in the region of bombarding energy where the compound-nucleus mechanism predominates. A method was proposed to obtain the angular momentum distribution of direct-interaction products in order to extend the isomer-ratio calculations to the region of energy where nuclear reactions proceed through this mechanism. (Diss. Abstr. Int., B)

22726 NUCLEAR g FACTOR OF THE 339 keV LEVEL OF ^{59}Ni. Wender, S. A.; Cameron, J. A. (McMaster Univ., Hamilton, Ont.). Can. J. Phys.; 52: No. 12, 1137-1138(15 Jun 1974).

The integral rotation of the angular distribution of 339 keV gamma rays from ^{59}Ni has been measured following (α,n) reactions in a magnetized iron target. The g factor of the $\frac{5}{2}^-$ first excited state of ^{59}Ni is 0.14 ± 0.06. (auth)

22727 STUDY OF NUCLEAR INTERACTIONS OF 200 GeV PROTONS IN EMULSION. Otterlund, I. (Univ. of Lund, Sweden). pp 427-431 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973). See CONF-730642-.

The results of an international collaboration on proton-nucleus interactions using nuclear emulsions exposed to a 200 GeV proton beam at the National Accelerator Laboratory, Batavia are presented. A large number of interactions have been analyzed including events with heavily-ionizing tracks and therefore distributions are given with all final nuclear states included in the data. The shower particle multiplicity was found to be $\langle n_s \rangle = 12.9 \pm 0.2$ and the average number of heavy prongs $\langle N_h \rangle = 7.4 \pm 0.2$. These results are impossible to interpret with any simple intranuclear cascade model. The shape of the angular distribution of particles produced and its variation with the number of heavy prongs N_h has been analyzed. (auth)

22728 COOLING PROBLEM IN THE $\gamma-\gamma$ ANGULAR CORRELATION FOR ^{75}Br. Koch, F. Stud. Univ. Babes-Bolyai, Ser. Phys.; 19: No. 1, 83-88(1974). (In Rumanian).

The operating technique and the design of a cooling installation used in the measurement of the $\gamma-\gamma$ angular correlation of ^{75}Br are described. (4 figures, 1 table) (tr-auth)

22729 NUCLEAR CAPTURE AT REST OF Ξ HYPERONS. Goel, S. P. (Kurukshetra Univ., India); Prakash, Y. Indian J. Pure Appl. Phys.; 12: No. 1, 51-56(Jan 1974).

The capture at rest of Ξ hyperons in emulsion nuclei is studied by computer simulation by using the Monte Carlo technique. Information obtained on the prong distribution and other characteristics of the Ξ -capture star is presented. The rates of production of hyperfragments and double Λ hyperfragments following Ξ capture are also estimated. (3 figures, 1 table) (auth)

Nuclear Properties and Reactions, 90 ≤ A ≤ 149

Refer also to abstracts 21896, 22162, 22271, 22584, 22610, 22622, 22633, 22650, 22689, 22692, 22701, 22704, 22711, 22720, 22724, 22725, 22729, 22776, 22793, 22798, 22801, 22804, 22805, 22808, 22874, and 22941.

22730 (ANL/NDM-6) EVALUATED NEUTRONIC CROSS SECTION FILE FOR NIOBIUM. Howerton, R.; Smith, A.; Guenther, P.; Whalen, J. (Argonne National Lab., Ill. (USA)). 1974. Contract W-31-109-eng-38. 63p. Dep. NTIS $6.25.

The formulation of an evaluated neutronic data file for niobium in the ENDF format is outlined; and the complete numerical file, presented. This file represents an updating, extension, and revision of the previously available file (defined in AP/CTR/TM-4), particularly including improved high-energy cross section files, gamma-ray production files, and corrections to the previous file where indicated. Qualitative uncertainty estimates are given. The present file should be particularly suitable for high-energy applied calculations such as are encountered in CTR technology problems. (auth) (4 figures, 1 table)

22731 (COO-2167-3, pp 72-77) NUCLIDIC MASS RELATIONSHIPS, MASS EQUATIONS, AND THE EFFECTIVE NEUTRON-PROTON INTERACTION. Janecke, J. 1974.

In Cyclotron Laboratory annual report, June 15, 1973-June 15, 1974.

22732 (IAEA-R-698-F) NUCLEAR DATA MEASUREMENTS. (a) Studies of Simple Nuclear Systems. (b) Nuclear Spectroscopy and Reaction Mechanism Investigations With Neutron Induced Reactions. Final Report, 15 December 1968-14 December 1971. Tomas, P. (International Atomic Energy Agency, Vienna (Austria)). Mar 1972. vp. INIS.

The program comprises studies of simple nuclear systems, nuclear spectroscopy, and investigation of reaction mechanisms with neutron-induced reactions. The experimental techniques applied are as follows: counter telescopes, nuclear emulsions, multiwire proportional chamber, time-of-flight analyzers, fast coincidence analyzers, and multiparameter analyzers. Two methods for performing kinematically complete experiments in neutron-induced reactions have been developed. A new neutron generator facility especially designed to yield low background has been built. Radiative processes on hydrogen, deuteron break-up, and multiparticle reactions induced by neutrons and charged particles have been studied. Correlation measurements and analyses have been performed at about 20 pairs of scattering angles. About 18 angular distributions and differential cross sections for (n,p), (n,d), (n,t) and (n,alpha) reactions have been measured and analyzed to obtain nuclear spectroscopic data. The total reaction cross sections for (n,p), (n,2n), (n,2p), (n,t) and (n,^{3}He) reactions have been measured for more than 50 isotopes. The technique of activation analysis and the method of radiochemical separation have been applied in the latter measurements. Three-body reactions have been used to obtain information about nuclear forces, nucleon-nucleon interaction and

reaction mechanisms. A critical evaluation and compilation of experimental and theoretical studies in this field has also been given. (INIS)

22733 (IEA-TI-22) RESEARCH IN NUCLEAR PHYSICS WITH THE REACTOR OF BRAZILIAN ATOMIC ENERGY INSTITUTE. Goldemberg, J. (Instituto de Energia Atomica, Sao Paulo (Brazil). Divisao de Fisica Nuclear). Aug 1972. 14p. (In Portuguese). INIS.

A survey is presented of the nuclear physics experiments in progress at the Atomic Energy Institute in São Paulo, Brazil, with emphasis on the work in nuclear resonant scattering, electron internal conversion and photofission. (INIS)

22734 (IKF-32) ANNUAL REPORT, 1973. (Frankfurt Univ. (F. R. Germany). Inst. fuer Kernphysik). 1973. 121p. (In German). Dep. NTIS (U. S. Sales Only) $9.25.

This report gives a summary of the scientific activities of the Institute for Nuclear Physics of the University of Frankfurt in the year 1973. Research during this period was conducted in the following areas: nuclear reactions and nuclear structure, atomic collision processes, heavy-ion physics, neutron diffractometry and spectroscopy, solid particle-track detectors, methods of nuclear analysis, data processing, and radiation protection. Eleven of the papers in this volume are separately title listed. (RWR)

For title listings of individual papers see: 22665, 22681, 22709, 22735–22739, 22775, 22840, and 22961.

22735 (IKF-32, pp 20-22) LIFETIMES FOR LEVELS OF ^{91}Nb AND COMPARISON WITH SHELL-MODEL VALUES. Schaefer, W.; Rauch, F. 1973. (In German).

22736 (IKF-32, pp 22-24) STUDY OF EXCITED STATES OF ^{92}Mo. Doerr, R.; Obst, E.; Rauch, F.; Schaefer, W.; Sehrt, G.; Duennweber, W.; Van Patter, D. M. 1973. (In German).

22737 (IKF-32, pp 24-25) INVESTIGATION OF THE NUCLEI ^{121}Sb AND ^{123}Sb BY COULOMB EXCITATION. Sehrt, H. G.; Stelzer, K.; Rauch, F. 1973. (In German).

22738 (IKF-32, pp 26-27) LEVEL SCHEME OF ^{97}Nb. Jdzko, J.; Feix, W.; Sehrt, G.; Stelzer, K. 1973. (In German).

22739 (IKF-32, pp 28-29) STUDY OF THE NUCLEUS ^{107}Cd BY THE (p,nγ) REACTION. Feix, W.; Schiffel, C.; Stelzer, K. 1973. (In German).

22740 (IS-T-622) GAMMA–GAMMA ANGULAR CORRELATION STUDIES OF CASCADES IN ^{138}Ba AND ^{142}Ce. Basinger, G. J. (Ames Lab., Iowa (USA)). Jul 1974. Contract W-7405-eng-82. 131p. Dep. NTIS $9.75.

Thesis.

Angular correlation measurements were made on the gamma-transition cascades involving the most intense transitions in coincidence with the 1436-keV transition in ^{138}Ba and with the 641-keV transition in ^{142}Ce. Mass-separated sources from the TRISTAN isotope separator were used, and the data were taken with a multi-detector angular correlation apparatus using one Ge(Li) detector and six NaI(Tl) detectors. The experimental configurations are described in detail along with the analysis procedures used. Values are given for the angular correlation coefficients, and limits of multipolarity mixing ratios are given where applicable. (auth)

22741 (JAERI-M-5552) ENERGY RELEASE FROM THE DECAY OF FISSION PRODUCTS. Tasaka, K.; Sasamoto, N. (Japan Atomic Energy Research Inst., Tokyo). Jan 1974. 26p. NTIS (US Sales Only).

The energy release rates of fission products have been calculated by summation of the contributions of respective fission product nuclides. An attempt is made to refine the existing values of beta or gamma energy release rates at short times after fission by including information on more fission products, mainly short-lived ones. In the calculation 506 radioactive and 125 stable nuclides are considered. The unknown nuclear data for short-lived nuclides are estimated theoretically or statistically. The Q values are obtained by using the semi-empirical mass formula of Myers and Swiatecki. The beta decay constant λ of the nucleus is derived from its Q value by using the empirical correlation between λ and Q. Feasibility of the method is evaluated through comparison of the calculated results with experiment. The results are in good agreement with the experimental ones for the gamma energy release rates short times after the fission; usefulness of the estimated nuclear data is thus indicated. The calculated decay powers are in good agreement with the calorimetric measurements by Day and Cannon. The present results of decay power also agree well with the compilations by Shure and by Stehn and Clancy for the respective cooling times. (auth)

22742 (KHFTI-73-9, pp 62-63) SEARCH FOR TWO PROTONS WITH SMALL RELATIVE MOMENTUM IN PHOTONUCLEAR REACTIONS AT HIGH ENERGIES. Antuf'ev, Yu. P.; Agranovich, V. L.; Kuz'menko, V. S.; Sorokin, P. V. (Physical-Technical Inst., Kharkov). 1973. (In Russian).

The first tests on the measurement of the yield of proton-proton pairs during the irradiation of targets with 1200-MeV photons were reported. The experimental results showed that during the interaction of the high energy particles with nucleon associations in nuclei the probability of the transfer of two nucleons of similar momenta is small. (tr-auth)

22743 (LBL-2940) MACROSCOPIC ASPECTS OF HEAVY ION REACTIONS. Thompson, S. G.; Moretto, L. G.; Jared, R. C.; Babinet, R. P.; Galin, J.; Fowler, M. M.; Gatti, R. C.; Hunter, J. B. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jun 1974. Contract W-7405-eng-48. 22p. (CONF-740646-2). Dep. NTIS $4.25.

From nobel symposium on superheavy elements; Ronneby, Sweden (10 Jun 1974).

Heavy ion beams of ^{40}Ar (288 MeV) and ^{84}Kr (~600 MeV) from Hilac acceleration and ^{14}N (100, 160, 250, MeV) and ^{20}Ne (250 MeV) from the 88" cyclotron have been used to bombard natural silver targets. Formation cross sections, angular distributions and kinetic energy distributions for reaction products in the range Z = 6 – 20 have been measured using gas ΔE – E telescopes. Kinetic energy distributions generally agree well with Coulomb repulsion energies for binary division. Angular distributions are discussed in terms of relaxation time for the mass asymmetry mode compared to rotational periods. (auth)

22744 (NP-20044, pp 79-82) MEASUREMENT OF HALF-LIFE IN ms REGION WITH A MECHANICAL CHOPPER. Hashizume, A.; Tendow, Y.; Katou, T.; Kumagai, H. Dec 1973.

22745 (ZfK-262, pp 57-59) ISOMERISM AND BAND STRUCTURE IN ^{107}Cd. Hagemann, U.; Brinckmann, H. F.; Fromm, W. D.; Heiser, C.; Rotter, H. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Sep 1973. (In German).

22746 (ZfK-262, pp 59-61) ENERGY LEVELS AND ISOMERISM IN ^{112}In. Fromm, W. D.; Brinckmann, H. F.; Hagemann, U.; Heiser, C.; Rotter, H. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Sep 1973. (In German).

22747 (ZfK-262, pp 67-70) LIFETIMES OF THE $11/2^-$ STATES IN ^{145}Eu, ^{143}Pm, ^{141}Pr, AND ^{139}La. Fromm, W. D.; Funke, L.; Schilling, K. D. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Sep 1973. (In German).

22748 (ZfK-262, pp 127-129) DENSITY DEPENDENCE OF TWO-PARTICLE FORCES OF THE MIGDAL TYPE AND INELASTIC NUCLEON SCATTERING. Reif, R. (Technische Univ., Dresden). Sep 1973. (In German).

22749 DELAYED PROTON EMISSION AND NUCLEAR STRUCTURE STUDIES. Karnakuhov, V. A. (Joint Inst. for Nuclear Research, Dubna, USSR). Nukleonika; 19: No. 5, 425-453(1974).

The phenomenon of delayed proton emission as an efficient tool for extracting the nuclear information is described with particular emphasis on the statistical aspect, i.e. the strength function, intermediate structure and fluctuations. (auth)

22750 SEARCH FOR PERTURBATIONS OF γ–γ DIRECTIONAL CORRELATIONS. Sarper, R.; McLain, M. E. Jr.; Wyly, L. D.; Braden, C. H. (Georgia Inst. of Tech., Atlanta). Phys. Rev., C; 9: No. 2, 754-759(Feb 1974).

γ–γ directional correlations in ^{154}Gd, ^{125}Te, ^{153}Eu, and ^{143}Pr that proceed through levels of lifetimes 1.2, 1.5, 3.8, and 4.2 nsec, respectively, have been studied with the application of a magnetic field parallel to one radiation in order to search for possible attenuation of the correlations. Attenuations were found for the 1270-123-keV cascade in ^{154}Gd (in general agreement with earlier work) and in ^{143}Pr, both of which have large magnetic susceptibilities. No attenuation was found for the 427-35-keV cascade in ^{125}Te and the isotropic correlation found for the 70-103-keV cascade in ^{153}Eu is inferred to be the true correlation. The result for the unattenuated correlation coefficient for the 293-57-keV cascade in ^{143}Pr is $A_2 = 0.18 \pm 0.02$. (auth)

22751 LOW-LYING STATES IN ^{111}In AND ^{113}In. Kim, H. J.; Robinson, R. L. (Oak Ridge National Lab., TN). Phys. Rev., C; 9: No. 2, 767-774(Feb 1974).

Levels in ^{111}In and ^{113}In below 1.62 MeV were investigated via the (p,n) and (p,nγ) reactions on ^{111}Cd and ^{113}Cd targets for an incident energy range of 2.7–5.2 MeV. The neutron groups populating the low-lying states were studied by the time-of-flight method, and the deexcitation γ rays were studied with Ge(Li) detectors. Several new levels in ^{111}In and ^{113}In were established including low-spin positive-parity states having nanosecond half-lives. The Q value for the ^{111}Cd(p,n)^{111}In reaction was determined to be −1.635 ± 0.020 MeV. (auth)

22752 ^{142}Nd(p,p′) REACTION ON ANALOG RESONANCES. Bimbot, L. (Univ. of Montreal); Lessard, L.; Santhanam, S.; Martin, R.; Dietzsch, O.; Spalding, D.; Schechet, K.; Foster, J. L. Jr. Phys. Rev., C; 9: No. 2, 741-753(Feb 1974).

The reaction ^{142}Nd has been measured on four analog resonances in the ^{142}Nd + p system at incident energies of 9.515, 10.250, 10.830, and 11.084 MeV. On each of the resonances spectroscopic factors are determined for those levels believed to have significant neutron particle-hole components. (auth)

22753 ^{96}Mo(d,p)^{97}Mo REACTION. Medsker, L. R.; Yntema, J. L. (Argonne National Lab., IL). Phys. Rev., C; 9: No. 2, 664-669(Feb 1974).

The ^{96}Mo(d,p)^{97}Mo reaction was studied with 16-MeV deuterons. Experimental angular distributions were analyzed by use of distorted-wave Born-approximation calculations to determine l values and spectroscopic strengths. The results are compared with previous data and the neutron configurations of ^{97}Mo are examined in comparison with neighboring molybdenum and zirconium nuclei. (auth)

22754 DISCOVERY AND ASSIGNMENT OF EXCITED 0^+ LEVELS IN EVEN-A Mo ISOTOPES. McEllistrem, M. T.; Brandenberger, J. D.; Sinram, K.; Glasgow, G. P.; Chung, K. C. (Univ. of Kentucky, Lexington). Phys. Rev., C; 9: No. 2, 670-673(Feb 1974).

The first excited 0^+ levels, some of which are previously unobserved, in each of the even-A isotopes 92, 94, 96, and 100, have energies of 2517 ± 0.5, 1742 ± 2, 1147, and 694 keV, respectively. These states were identified using γ-ray data from (n,n′γ) reactions and the strong anisotropy of the angular distribution of (n,n′) reactions in $0^+ \rightarrow 0^+$ transitions. (auth)

22755 COLLECTIVE EXCITATION OF ^{101}Pd FOLLOWING (HEAVY ION, xn) REACTIONS. Simms, P. C.; Smith, G. J.; Rickey, F. A.; Grau, J. A.; Tesmer, J. R.; Steffen, R. M. (Purdue Univ., Lafayette, IN). Phys. Rev., C; 9: No. 2, 684-698(Feb 1974).

States excited by the ^{99}Ru(α, 2nγ)^{101}Pd, ^{88}Sr(^{16}O,3nγ)^{101}Pd, and ^{92}Zr(^{12}C,3nγ)^{101}Pd reactions have been studied by measuring the γ-ray yield as a function of incident projectile energy, γ–γ coincidences, γ-ray angular distributions, and γ-ray linear polarizations. Three intense γ-ray cascades were observed. These cascades are produced by quasirotational bands built on the $\frac{5}{2}^+$, $\frac{7}{2}^+$, and $11/2^-$ intrinsic states of the nucleus. A decay scheme is given which includes states with energy up to 6488 keV and angular momentum up to $\frac{35}{2}$. The quasirotational bands seen in ^{101}Pd are similar to the bands in the adjacent even–even nuclei which suggests that this odd-A nucleus can be described as a particle decoupled from an even–even core. A cascade of seven γ rays in ^{102}Rh was also observed following the ^{92}Zr(^{12}C,pn)^{102}Rh reaction. (auth)

22756 LEVELS IN ^{146,147,148}Gd OBSERVED FOLLOWING THE DECAY OF THEIR TERBIUM PARENTS INCLUDING A NEW ISOTOPE, ^{148}Tb. Newman, E. (Oak Ridge National Lab., TN); Toth, K. S.; Hensley, D. C.; Schmidt-Ott, W. D. Phys. Rev., C; 9: No. 2, 674-683(Feb 1974).

The decay schemes of the following terbium isotopes were investigated: 2.3 ± 0.2-min ^{149}Tb, 1.9 ± 0.1-min and 1.6 ± 0.1-h ^{147}Tb, and a previously unreported 23 ± 2-sec nuclide assigned to ^{148}Tb. These radioactivities were produced by bombarding ^{141}Pr with ^{12}C ions accelerated in the Oak Ridge isochronous cyclotron. Both singles and coincidence γ-ray spectral measurements were made. The data for 2.3-min ^{149}Tb are in excellent agreement with the recently published results of Bowman, Haenni, and Sugihara. Also confirmed is their discovery of a new 1.9-min high-spin isomer in ^{147}Tb. Additional information is provided concerning its decay properties. Levels in ^{147}Gd populated by this (presumably $h_{9/2}$) ^{147}Tb state are: 997.6 keV, $\frac{9}{2}^-$; 1397.7 keV, $(\frac{9}{2}^-)$; (1778.9 keV); and 1797.8 keV, $(\frac{9}{2}^-)$. Contrastingly, the 1.6-h low-spin (probably $d_{5/2}$) ^{147}Tb isomer was found to populate the following ^{147}Gd levels: 0 keV, $\frac{7}{2}^-$; 1152.2 keV, $\frac{5}{2}^-$; 1292.0 keV, $(\frac{5}{2}^+)$; 1411.5 keV, $(\frac{5}{2}^+)$; 1699.2 keV; 1759.1 keV; and 1846.6 keV, $(\frac{9}{2}^-)$. The assignment of the new 23-sec activity to ^{148}Tb is based primarily on the fact that five of its γ-rays have been observed by Kownacki et al. in a ^{144}Sm(α,2nγ) study. Levels in ^{148}Gd seen in the decay of ^{148}Tb (probable spin of 3) are as follows: 1579.5 keV, 2^+; 2658.4 keV; 4^+; 2982.4 keV, 6^+; 2996.9 keV; 3099.4 keV; (3139.6 keV); and 3313.4 keV. In contrast to the results of Kownacki et al. γ rays either feeding or deexciting their tentatively proposed 3^- level at 1584.5 keV were not observed. (auth)

22757 STUDY OF THE LOW LEVELS IN ^{127}I USING THE ^{127}I(n,n′γ) REACTION. Sinclair, D. Kingston, Ont.; Queen's Univ. (1972). 173p.

Thesis.

The ^{127}I(n,n′γ) reaction has been studied for incident neutron energies up to 2 MeV. Singles spectra were measured using an iodine sample and a Ge(Li) detector. Gamma–gamma coincidence data were recorded using the Ge(Li) detector together with a NaI(Tl) detector which served both as the scattering sample and a γ-ray detector. From these data the level energies and γ-ray branching ratios were determined; the decay scheme for the low energy levels was confirmed and twenty-four new levels at higher energies were established. By using the ^{23}Na(n,n′γ) reaction cross section as a calibration, the ^{127}I(n,n′γ) cross sections were found. Calculations of the reaction cross sections based on the statistical compound nucleus model were carried out. These calculations required transmission coefficients for each of the neutron channels, and a more accurate method of calculating these coefficients was found. When the improved transmission coefficients were used, the calculated and measured cross sections were in good agreement for levels of known spins. The measured cross sections together with other relevant data were used to establish the spins of eleven other levels. The resulting spectrum was compared with the prediction of the intermediate coupling model; good agreement was obtained when the observed anharmonic and quasiparticle structure of the core was included. (auth)

22758 DECAY OF ^{143}Eu. Kennedy, G.; Gujrathi, S. C.; Hinrichsen, P. F. (McGill Univ., Montreal). Can. J. Phys.; 52: No. 10, 847-853(15 May 1974).

A high resolution study of γ-ray transitions in ^{143}Sm following the β^+ decay of ^{143}Eu has been made using Ge(Li) detectors. Fifty-seven γ rays are assigned to the decay of ^{143}Eu, and the ground-state spin of ^{143}Eu is established as $\frac{5}{2}^+$. Spin and parity assignments are made on the basis of γ-ray branching, deduced log ft values, and by comparison with previous (p,d) reaction data. Good agreement between experiment and predictions of the intermediate coupling model suggests that this model adequately accounts for the low-lying levels of ^{143}Sm. (auth)

22759 MEASUREMENT OF REDUCED RADIATIVE TRANSITION PROBABILITY BY ELECTRON SCATTERING. Yen, R. Y. New Haven; Yale Univ. (1973). 172p. University Microfilms Order No. 74-13,047.

Thesis (Ph. D.).

The nucleus ^{114}Cd had long been considered to be one of the best examples of a harmonic vibrational nucleus. However, the finding of a surprisingly large quadrupole moment for the first 2^+ state has destroyed that simple picture, and has attracted the attention of many experimentalists. Yale University's Electron Accelerator was used to study the first 2^+ state of ^{114}Cd by inelastic electron scattering. The form factor as a function of momentum transfer q_{tr}, in a range of 0.25 to 0.58 F^{-1}, was obtained by angular distribution measurements performed at incident energies of 30 to 60 MeV. The data were analyzed explicitly in terms of the lower radial moments of the transition charge density ρ_{tr} (r) by using a second-order Born approximation calculation. Since this was the first use of this analysis method, it was tested by comparing results to those obtained by a conventional phase-shift DWBA calculation. Two radial moments of the transition charge density, namely the reduced radiative transition probability B(E2↑) and transition radius (squared) $\langle r_{tr}^2 \rangle$ were extracted. In addition, the B(E2↑) and $\langle r_{tr}^2 \rangle$ of the first excited state of ^{60}Ni and ^{6}Li were also obtained by applying the same method to inelastic electron scattering data. These results are presented and compared with those of other experiments. The set of measurements presented suggested that the quantities B(E2↑) and $\langle r_{tr}^2 \rangle$, which represent in principle all the information which can be extracted from electron nucleus scattering at low momentum transfers, are correlated in such a way as to limit significantly the accuracy to which each parameter may be determined independently of the other. (Diss. Abstr. Int., B)

22760 APPLICATIONS OF THE REORIENTATION EFFECT OF COULOMB EXCITATION TO THE NUCLEI ^{114}Cd, ^{122}Te, ^{124}Te, AND ^{130}Te. Larsen, R. D. Lafayette, IN; Purdue University (1973). 142p. University Microfilms Order No. 74-15,189.

Thesis (Ph. D.)

A Coulomb excitation experiment was performed on the first 2^+ states of ^{114}Cd, ^{122}Te, ^{124}Te, and ^{130}Te. The relative excitation

probabilities of the first 2^+ states were measured at backward and forward projectile scattering angles by using ^{32}S projectiles with energies from 50 to 65 MeV. Particle–γ coincidences were used to identify the inelastic events. The data were analyzed with the aid of the Winther–deBoer multiple Coulomb excitation program. The projectile and bombarding energies were chosen to minimize the effect on the experiment of Coulomb excitation of the first 2^+ state via the second 2^+ state. Separate angular distribution measurements were made as a function of target recoil velocity to determine the influence of the deorientation effect. By comparing the results of this work for ^{114}Cd with the results of the high excitation probability experiment of Berant et al., it was possible to deduce that the sign of the interference term due to Coulomb excitation of the first 2^+ state via the second 2^+ state of ^{114}Cd is positive. The static quadrupole moment of the first 2^+ state of ^{114}Cd with positive interference was determined to be $Q_{2+} = -0.35 \pm 0.07$ b. The measured quadrupole moments of the tellurium isotopes were negative (or close to zero in the case of ^{130}Te), in agreement with the trend of most experimental results and disagreeing with some theoretical predictions. By using model-dependent results and the determination of positive interference in the case of ^{114}Cd, the interference can be predicted to be positive for tellurium isotopes with $Q_{2+} < 0$. The extracted quadrupole moments of the first 2^+ states for positive interference are then $Q_{2+} = -0.43 \pm 0.08$ b, -0.49 ± 0.08 b, and -0.08 ± 0.08 b for ^{122}Te, ^{124}Te, and ^{130}Te, respectively. For negative interference these results are $Q_{2+} = -0.21 \pm 0.08$ b, -0.28 ± 0.08 b, and $+0.001 \pm 0.08$ b. (Diss. Abstr. Int., B)

22761 NUCLEAR STRUCTURE STUDIES IN ^{106}Pd. Pinkerton, J. E. Columbia, SC; University of South Carolina (1973). 138p. University Microfilms Order No. 74-16,185.

Thesis (Ph. D.).

The structure of the vibrational nucleus ^{106}Pd was investigated by using gamma–gamma directional correlations and internal conversion measurements. The main purpose of the investigation was to measure the directional correlations of gamma-ray cascades which originate from energy levels which might be identified as levels of the three- and four-phonon excitations, for the purpose of fixing the angular momentum assignments of these levels. Eleven directional correlations of gamma-ray cascades in ^{106}Pd were measured following the decay of 30-sec ^{106g}Rh. The following E2/M1 multipole mixing ratios were obtained: $-53 \leq \delta(616) \leq -15$, $\delta(1061) = 1.20 \pm 0.15$, $\delta(1113) \sim -1.5$, $1.9 \leq \delta(1925) \leq 3.5$, and $1.5 \leq \delta(1988) \leq 4$. The intensity ratio of internal conversion lines was found to be $I(1113K)/I(1192K) \sim 0.5$. A search for K-shell internal conversion intensities indicative of higher multipoles in the 1796-keV transition produced evidence that this transition is M1 or E2 in character. The levels at 2189, 2241, 2437, and 2500 keV are each assigned a spin of 2, and levels at 1704, 2278, 2306, and 2624 keV are each assigned a spin of 0. The energy levels are compared with the levels predicted by the vibrational model of Ferreira and his co-workers up through the four-phonon energy region. (RWR)

22762 LEVELS OF ^{147}Sm, ^{149}Sm, AND ^{151}Sm USING THE (p,d) REACTION. Graham, M. C. Amherst, MA; University of Massachusetts (1974). 230p. University Microfilms Order No. 74-16,305.

Thesis (Ph. D.).

Protons of 20 MeV energy were used on targets of ^{148}Sm, ^{150}Sm, and ^{152}Sm with enrichments of 95.4%, 95.1%, and 99.18%, respectively. Levels were observed from 0.0 to 2.097 MeV in ^{147}Sm, from 0.0 to 2.046 MeV in ^{149}Sm, and from 0.0048 to 1.351 MeV in ^{151}Sm. Deuteron angular distributions were obtained with a multigap spectrograph at 22 angles ranging from 5 to 170°. Resolution was ~30 keV for the levels of ^{147}Sm, 35 keV for the levels of ^{149}Sm, and ~40 keV for the levels of ^{151}Sm. Spin and parity assignments were made. The computer code DWUCK was used to verify l assignments. Spectroscopic factors were determined and pairing theory formalism was used to extract quasi-particle energies and pairing strength parameters for ^{149}Sm and ^{147}Sm. In addition, band structure was observed in ^{151}Sm. (Diss. Abstr. Int., B)

22763 NUCLEAR STRUCTURE STUDIES OF $^{95,96}Mo$, ^{125}Sb, $^{194,195,196}Pt$, AND $^{182,184,186}W$ ISOTOPES UTILIZING GAMMA–GAMMA DIRECTIONAL CORRELATION, POLARIZATION-DIRECTIONAL CORRELATION, AND ION-IMPLANTATION-PERTURBED-ANGULAR-CORRELATION (IMPACT) TECHNIQUES Garber, D. A. Lafayette, IN; Purdue University (1973). 253p. University Microfilms Order No. 74-15,164.

Thesis (Ph. D.).

Directional correlations and polarization-directional correlations were measured for several gamma–gamma cascades in ^{95}Mo, ^{96}Mo, and ^{125}Sb populated from the decay of ^{95}Tc, ^{96}Tc (4.3d), and ^{125}Sn (9.6d). Unique spin assignments and multipole mixing ratio assignments were made. These values were compared with the predictions of various nuclear models. In addition, the ion-implantation-perturbed-angular-correlation technique (IMPACT) was used to measure nuclear g factors of excited states in $^{194,195,196}Pt$, ^{95}Mo, and ^{182}W. A beam of 30- to 36-MeV ^{16}O ions was used to Coulomb excite and recoil implant the various nuclei into polarized ferromagnetic backing foils. The precession of the angular distribution of the deexcitation gamma rays, which is proportional to the excited-state g factor, was measured. In addition, Larmor precessions were measured for the first 2^+ excited states of $^{184,186}W$ in a cobalt host. (RWR)

22764 LIFETIMES OF NUCLEAR LEVELS IN THE DECAYS OF SOME MASS-SEPARATED FISSION PRODUCTS. Morman, J. A. Ames, IA; Iowa State University (1974). 90p. University Microfilms Order No. 74-15,437.

Thesis (Ph. D.).

The nuclei ^{141}Cs, ^{140}Cs, and ^{136}Xe were examined for the presence of energy levels with measurable half-lives in the nanosecond range. The lifetime measurement system is described along with the least-squares fitting procedure developed to analyze the data. In ^{141}Cs, two energy-level half-lives were measured, the 69-keV level with a half-life of 23.3 ± 0.7 ns and the 106-keV level with a half-life of 8.7 ± 0.2 ns. ^{140}Cs has three levels whose half-lives were measured: the 14-keV level, 471 ± 51 ns; the 65-keV level, 3.7 ± 0.3 ns; and the 103-keV level, 7.2 ± 0.5 ns. No levels in ^{136}Xe were found to have half-lives within the measuring range of the equipment. Also, for each nucleus, upper limits for the half-lives of other levels are given. The results are then compared with the theoretical predictions for the lifetimes, and the possible multipolarities of the transitions are discussed. (Diss. Abstr. Int., B)

22765 MECHANISM OF INELASTIC SCATTERING OF NEUTRONS WITH INITIAL ENERGY 9.1 ± 0.2 MeV ON Nb. Biryukov, N. S.; Zhuravlev, B. V.; Kornilov, N. V.; Plyaskin, V. I.; Sal'nikov, O. A.; Trykova, V. I. Yadern. Fiz.; 19: No. 6, 1201-1206 (Jun 1974). (In Russian).

Energy spectra of neutrons inelastically scattered on Nb under the angles of 30, 60, 90, 120, 150° at the initial energy of 9.1 ± 0.2 MeV are obtained. The measurements were carried out by means of the time-of-flight method at the 150 cm cyclotron of PEI. It is shown that considering the reaction mechanism in framework of the Griffin model one may not only describe the integral spectrum of the inelastically scattered neutrons, but also to separate the processes contributing to the symmetrical and asymmetrical angular distribution. (auth)

22766 HIGH-ENERGY PHYSICS AND NUCLEAR STRUCTURE. Proceedings of the Fifth International Conference, Uppsala, Sweden, June 18–22, 1973. Tibell, G. (ed.). New York; American Elsevier Publishing Company, Inc. (1974). 461p. (CONF-730642-).

Separate abstracts are prepared for 75 of the 76 papers presented. One item previously appeared in NSA as 29: 11287. (CES)

For abstracts of individual papers see: 21215, 21941–21943, 22177–22179, 22237, 22263–22265, 22306, 22307, 22340, 22354, 22393, 22406–22412, 22422, 22427, 22594–22602, 22648–22662, 22727, 22767, 22832, 22935–22956, and 22982.

22767 NEUTRON SPECTRA FROM THE NEGATIVE MUON ABSORPTION BY HEAVY NUCLEI AND THE RESONANCE MODEL OF NUCLEAR REACTIONS. Evseev, V. S.; Mamedov, T. N. (Joint Inst. for Nuclear Research, Dubna, USSR). pp 308-311 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973). See CONF-730642-.

Neutron energy spectra are measured in the energy range $1.6 \leq E_n \leq 9.6$ MeV from the reaction of nuclear absorption of μ^--mesons in ^{127}I and ^{232}Th. In the low-energy part of the spectrum the "temperature" values T of the nucleus produced after emission of the first neutron (1.28 ± 0.05 MeV and 1.46 ± 0.06 MeV for ^{126}Te and ^{231}Ac, respectively) were determined, as were also the density parameters of energy levels "a" of this nucleus. The comparison of the data on μ^--capture with the statistical model predictions shows that this model does not describe the decay process of the quasibound states of an intermediate nucleus. As such states are of few-particle character (in correspondence with the resonance model of nuclear reactions) one has to assume that they do not change their nature up to the neutron decay, even in the heaviest nuclei. (auth)

22768 CHARGE DISTRIBUTION IN NUCLEI. Bellicard, J. B. (CEN de Saclay, Gif-sur-Yvette, France). J. Phys. (Paris), Colloq.; No. 4, 29-41 (1973). (In French).

From Centenary congress on the French Physical Society; Vittel, France (28 May 1973).

Elastic electron scattering and μ-mesic atoms are complementary methods to determine nuclear charge densities. Recent theoretical calculations, like those using the Hartree–Fock method, give an accurate description of the charge density; they have suggested an independent model analysis of the experimental data giving rho(r) with error bars. This new method has already given interesting results which confirm the finest strucutres given by the theory. (FR)

22769 NUCLEAR MATTER DISTRIBUTION, ELASTIC SCATTERING OF LIGHT AND HEAVY IONS. Fernandez, B. (CEN de Saclay, Gif-sur-Yvette, France). J. Phys. (Paris), Colloq.; No. 4, 43-53(1973). (In French).

From Centenary congress on the French Physical Society; Vittel, France (28 May 1973).

Elastic scattering of protons, deuterons, α-particles and heavy ions is reviewed and discussed as a means to determine nuclear matter distributions. Recent results indicate that, in spite of some as yet unsolved problems, these methods allow the determination of nuclear matter radii within ± 0.1 fm. (FR)

22770 SPHERICAL HARTREE–FOCK CALCULATIONS WITH AN EFFECTIVE INTERACTION. Flocard, H. (Paris Univ., Orsay, France). J. Phys. (Paris), Colloq.; No. 4, 87-100 (1973). (In French).

From Centenary congress on the French Physical Society; Vittel, France (28 May 1973).

Two examples of Hartree–Fock calculations with effective interactions are presented: first, those made by Campi and Sprung with the local density approximation; second, calculations made in Orsay with the Skyrme effective interaction. The parametrization with a special emphasis on the influence of the nonlocality for nonmagic nuclei is discussed. A set of parameters is derived which predicts the total nuclear binding energies for the whole mass table with a mean error of 5 MeV, when the pairing and deformation corrections are included. (FR)

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Refer also to abstracts 21937, 22584, 22649, 22650, 22719, 22744, 22749, 22750, 22762, 22763, 22813, 22823, 22829, 22839, and 22859.

22771 (COO-2167-3, pp 39–42) STRUCTURE OF ^{159}Tb VIA PROTON TRANSFER REACTIONS. Splett, J.; Parkinson, W. C. 1974.

In Cyclotron Laboratory annual report, June 15, 1973–June 15, 1974.

22772 (COO-2167-3, pp 42–64) STUDY OF ONE-QUASIPARTICLE STATES IN ^{165,165}Ho OBSERVED IN THE (^{3}He,d) AND (α,t) REACTIONS. Lewis, D. A.; Broad, A. S.; Gray, W. S. 1974.

In Cyclotron Laboratory annual report, June 15, 1973–June 15, 1974.

22773 (COO-3496-44, pp 28-33) STUDY OF THE ^{192}Os(p,t)^{190}Os, ^{190}Os(p,t)^{188}Os AND ^{188}Os(p,t)^{186}Os REACTIONS. Thompson, R. C.; Huizenga, J. R.; Burke, D. G.; Elze, T. W.; Boyno, J. S. 1974.

In studies of nuclear fission, low-energy nuclear reactions and transuranic nuclei.

22774 (IAE-2290) GAMMA SPECTRUM MEASUREMENT FROM THE ^{155}Gd(n,γ) REACTION WITH USE OF A GADOLINIUM COMPENSATING FILTER. Efimov, B. V.; Sokolovskii, L. L. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1973. 12p. (In Russian). INIS.

The spectrum of γ rays from the reaction ^{155}Gd(n,γ) was measured with a Ge(Li) spectrometer. A filter of Gd was used for balancing the contributions of the individual resonances of ^{155}Gd. Through measured average intensities of 22 γ transitions, J^π of the final states were determined, consistent with known data. A comparison of the results with data obtained earlier showed that the filter of Gd achieved a decrease of spread in the normalized intensities of the γ transitions of 20%, and indicated the possibility of the presence of correlations between radiative and reduced neutron widths for two γ transitions in rotational bands. (6 figures, 1 table) (tr-auth)

22775 (IKF-32, pp 8-9) MEASUREMENT OF QUADRUPOLE AND HEXADECAPOLE MOMENTS IN RARE EARTHS. Wollersheim, H. J.; Wilcke, W.; Elze, T. W. 1973. (In German).

22776 (INIS-MF-1168-1, pp vp, 35p) NUCLEAR SPECTROSCOPIC INVESTIGATIONS OF INTERMEDIATE NUCLEI. Low Lying Levels in Even Gadolinium and Platinum Nuclei. Finger, M. (Joint Inst. for Nuclear Research, Dubna, USSR). 1973.

From Finnish summer school in nuclear physics; Liperi, Finland (11 June 1973).

Recent results obtained in the nuclear spectroscopic investigation of the properties of low lying levels in even gadolinium and platinum nuclei using YASNAPP and ISOLDE facilities, respectively, are given. (JFP)

22777 (INIS-MF-1168-2, pp vp, 24p) INVESTIGATION OF NUCLEI FAR FROM THE STABILITY REGION. Properties of the Light Hg Isotopes. Fenyes, T.; Mahunka, I.; Mate, Z. (Inst. of Nuclear Research, Debrecen, Hungary). 1973.

From Finnish summer school in nuclear physics; Liperi, Finland (11 June 1973).

Research on the production and nuclear spectroscopic investigation of the neutron deficient Tl isotopes in order to learn about the structure of light mercury isotopes is summarized. (JFP)

22778 (JINR-P1-7962) ENERGY SPECTRA OF PHOTONEUTRONS FROM HEAVY ELEMENTS. Evseev, V. S.; Mamedov, T. N.; Selyugin, O. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1974. 15p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

Neutron energy spectra from the photo-excitation of Ta, Pb, Bi and Th nuclei by bremsstrahlung of a maximum energy of 31 MeV have been measured in the energy range of $2 \leq E_n \leq 5$ MeV. The T-temperature values for the nucleus, after the first neutron emission, have been determined to be 1.01 ± 0.04; 1.12 ± 0.04; 1.11 ± 0.04 and 1.25 ± 0.05 for Ta, Pb, Bi and Th, respectively. The comparison of the nuclear level densities with the predictions of the nuclear reaction statistical theory shows that this theory does not describe the decay of the collective states of a nucleus of the giant dipole resonance type. (auth)

22779 (JINR-P3-7980) NEUTRON RESONANCE PARAMETERS OF ^{161}Dy AND ^{163}Dy ISOTOPES. Karzhavina, E. N.; Kim Sek Su; Popov, A. B.; Faikov, Kh. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1974. 20p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

Neutron resonance spins for ^{161}Dy and ^{163}Dy were measured by the gamma-quantum multiplicity method by using the neutron spectrometer (Laboratory of Neutron Physics, JINR) with the resolution of 16 ns/m. The spins and neutron widths were determined for 44 resonances of ^{161}Dy and for 38 resonances of ^{163}Dy. The following values of the strength functions were obtained: for ^{161}Dy, $S_{J=2} = (1.96 \pm 0.65) \times 10^{-4}$, $S_{J=3} = (1.33 \pm 0.42) \times 10^{-4}$; and for ^{163}Dy, $S_{J=2} = (2.1 \pm 0.7) \times 10^{-4}$, $S_{J=3} = (1.0 \pm 0.35) \times 10^{-4}$. (5 figures, 4 tables) (auth)

22780 (JINR-P6-7897) GAMMA-RADIATION OF ^{160}Ho. Aleksandrov, A. A.; Buttsev, V. S.; Vylov, Ts.; Grigor'ev, E. P.; Gromov, K. Ya.; Kalinnikov, V. G.; Lebedev, N. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1974. 20p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

^{160}Er and ^{160}Ho isotopes were obtained from the internal and extracted proton beams of the JINR synchrocyclotron. The ^{160}Ho γ-ray spectrum was studied in detail by using Ge(Li) detectors. For most of γ transitions the types of multipolarities were determined. The internal conversion coefficient was measured for the ^{160m}Ho ($a_{k\delta0} = 2.0 \pm 0.6$) transition. The isomer with $T_{\frac{1}{2}} = 7$ min, ascribed to ^{160}Ho, was not observed. An estimate of the yield in the deep spallation Ta + p reaction is given for an isomer having $T_{\frac{1}{2}} = 1$ hour. (1 table) (auth)

22781 (JINR-P6-8000) ^{158}Ho RADIATION. Aleksandrov, A. A.; Buttsev, V. S.; Vylov, Ts.; Grigor'ev, E. P.; Gromov, K. Ya.; Kalinnikov, V. G.; Lyatushinskii, A.; Stegailov, V. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1974. 16p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

The radioactive ^{158m,g}Ho isotope has been prepared by means of the internal and extracted beams of the Dubna synchrocyclotron by irradiating a Ta target. Reaction products were separated by the radiochemical method and then protons were separated by the electromagnetic method. The spectra of gamma-rays, gamma-gamma coincidences and internal conversion electrons have been

studied with the help of Ge(Li) and Si(Li) semiconductors. About 40% of the 170 observed gamma-transitions were unknown earlier. The types of multipolarities for many gamma-transitions have been determined. The yield of the ^{159}Ho isomer (9^+, 21 minutes) in the Ta deep spallation reaction by protons with E_p = 660 MeV and in the ^{162}Dy(p,5n), E_p = 54 MeV reaction has been found to be about 0.05 of the ^{159}Ho (2^-, 27 min) isomer yield. (auth)

22782 (ZfK-260) INVESTIGATION OF ^{185}W AND ^{187}W IN THE (n,γ) REACTION. Prade, H.; Andrejtscheff, W.; Manfrass, P.; Mohsen, M.; Seidel, W.; Beitins, M. R.; Simonova, L. I. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). Jul 1973. 27p. (In German). Dep. NTIS (US Sales Only) $4.50.

The level schemes of ^{185}W and ^{187}W have been studied in the (n,γ) reaction up to excitation energies of about 2.0 MeV and 3.0 MeV, respectively. The singles γ-ray spectra were measured with Ge(Li)-detectors and conversion electrons from the reaction ^{186}W(n,e)^{187}W were registered up to 800 keV with a β-spectrograph. The neutron binding energies of ^{185}W and ^{187}W were determined as B_n = (5754.1 ± 1.0) keV and B_n = (5466.7 ± 1.0) keV, respectively. Seventeen new states in ^{185}W and 8 new states in ^{187}W partly proposed by (d,p) and (d,t) experiments could be arranged in the level schemes. Several levels were found to be populated directly from the capture states. Using the method of delayed γγ-coincidences with Ge(Li)-NaJ(Tl)-detectors the lifetime of the 350.6 keV level $^1/_2^-$[503] was measured to be $T_{1/2}$ = (5 ± 1) ns. From the excitation spectrum of the 350.6 keV level, the existence of a $^9/_2$ $^1/_2^-$[503] level at 493.5 keV can be proposed. The results concerning energies of band heads and rotational states as well as absolute and relative γ-ray transition probabilities are discussed in terms of the Nilsson theory taking into consideration pairing correlations and rotation-particle coupling. (auth)

22783 (ZFK-262) JOINT ANNUAL REPORT, 1973. Netzband, D. (ed.). (Deutsche Akademie der Wissenschaften zu Berlin (German Democratic Republic); Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). Sep 1973. 297p. (In German). Dep. NTIS (U. S. Sales Only) $18.00.

Short reports are presented which can be grouped into the following categories: nuclear reactions; nuclear spectroscopy; nuclear theory; applied methods of nuclear physics; mass separator, analytical and preparative work; accelerators; nuclear electronics and methods; and computer codes. A list of publications and lectures is also included. Nineteen of the papers are separately title listed. (RWR)

For title listings of individual papers see: 22585, 22632, 22688–22690, 22715, 22716, 22745–22748, and 22784–22791.

22784 (ZfK-262, pp 76-78) BAND MIXING IN ODD ERBIUM ISOTOPES. Andrejtscheff, W.; Manfrass, P.; Prade, H.; Schilling, K. D.; Seidel, W.; Winter, G. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Sep 1973. (In German).

22785 (ZfK-262, pp 82-83) ON THE DECAY ^{169}Yb(EC)^{169}Tm. Funke, L.; Hedt, G.; Dubbers, F.; Sodan, H. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Sep 1973. (In German).

22786 (ZfK-262, pp 83-85) STUDY OF ^{169}Tm WITH THE (p,2n) REACTION. Funke, L.; Kemnitz, P.; Sodan, H.; Will, E.; Winter, G. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Sep 1973. (In German).

22787 (ZfK-262, pp 85-86) $^1/_2^+$[411] AND $^1/_2^-$[541] ROTATIONAL BANDS IN ^{175}Lu. Winter, G.; Andrejtscheff, W.; Funke, L.; Manfrass, P.; Sodan, H. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Sep 1973. (In German).

22788 (ZfK-262, pp 86-88) NANOSECOND ISOMERS IN ^{176}Lu. Seidel, W.; Andrejtscheff, W.; Manfrass, P. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Sep 1973. (In German).

22789 (ZfK-262, pp 92-94) ROTATIONAL BANDS AND γ-TRANSITION PROBABILITIES IN ^{179}Ta. Manfrass, P.; Andrejtscheff, W.; Kemnitz, P.; Will, E.; Winter, G. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Sep 1973. (In German).

22790 (ZfK-262, pp 95-96) ABSOLUTE γ-TRANSITION PROBABILITIES IN ^{182}Ta. Andrejtscheff, W.; Manfrass, P.; Seidel, W. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Sep 1973. (In German).

22791 (ZfK-262, pp 147-149) PHENOMENOLOGICAL DESCRIPTION OF THE GROUND-STATE ROTATIONAL BANDS IN EVEN–EVEN NUCLEI. Thang, N. D.; May, F. R.; Muenchow, L. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Sep 1973. (In German).

22792 EXCITED STATES WITH LARGE SPINS IN EVEN–EVEN NUCLEI. Kashuba, I. E.; Kotishevskaya, E. Yu.; Ovcharenko, V. I. (Inst. of Nuclear Research, Kiev). Ukr. Fiz. Zh. (Russ. Ed.); 19: No. 5, 805-812(May 1974). (In Russian).

Spectra of the ^{154}Gd, ^{158,160,162}Dy, ^{168,160,162}Er, and ^{166,168}Yb nuclei where the states with high spin values have been recently found are considered as affected by deformability. Parameters of the nuclei shape and deformability are determined. The spin values are determined to which the nucleus may be considered as a deformable rotator. (auth)

22793 MOESSBAUER EFFECT DATA INDEX. Covering the 1972 Literature. Stevens, J. G.; Stevens, V. E. (eds.). New York; Plenum Publishing Corporation (1973). 493p. $37.50.

The volume begins with instructions on the use of the Moessbauer Effect Data Index, and then offers four reviews on Moessbauer spectroscopy. Contacts for equipment, sources, and supplies for Moessbauer spectroscopy are given. These are followed by tables and graphs for Moessbauer spectroscopy, and the 1972 data index. The latter part of the book contains the 1972 topical reference lists, addendum references list, 1972 master reference list, 1972 alphabetical author index, and 1973 partial reference list. (RWR)

22794 OPTICAL PUMP EXPERIMENTS ON MERCURY ISOTOPES WITH RESPECT TO β STABILITY. Kluge, H. J. (Johannes Gutenberg-Univ., Mainz). pp 377-387 of Physik 1973. Weinheim, Ger.; Physik Verlag GmnH (1973). (In German).

From 37th physicists conference; Hamburg, F. R. Germany (24 Sep 1973). See CONF-730993-.

The development and use of an optical pump method for the determination of the ground-state properties such as nuclear spin, nuclear moment, and nuclear volume of short-lived Hg isotopes was described. The on-line optical pump and the experimental arrangement were discussed. Values obtained for the isotopic displacement of short-lived Hg isotopes were reported and discussed. (JSR)

22795 EXPERIMENTAL INVESTIGATION OF THE DIRECTIONAL DISTRIBUTION OF K-α X RAYS FROM ELECTRON CONVERSION IN ^{169}Tm. Salie, D. L. Winnipeg, Manitoba; Univ. of Manitoba (1972). 129p.

Thesis.

The directional correlation coefficients and anisotropies involving the K_α X-rays generated by internal conversion were measured for several cascades in ^{169}Tm. The experimental anisotropies were $A(K_\alpha-\gamma_{131})$ = −0.065(19), $A(K_\alpha-\gamma_{118})$ = −0.038(22), $A(K_\alpha-(e_{177K}+e_{131L}))$ = −0.031(28), $A(K_\alpha-e_{198K})$ = −0.006(26), $A(K_\alpha-\gamma_{177})$ = −0.022(53) and $A(K_\alpha-\gamma_{198})$ = −0.002(17). It is suggested that these anisotropies are caused by a dynamic and possibly a static electric quadrupole interaction between the highly deformed nucleus and the K shell electrons when the nucleus de-excites by the highly retarded 177 keV and 198 keV transitions. The experimental values can be explained if the interaction is assumed to add $d_{3/2}'$ and $d_{5/2}'$ waves to the normal $1s_{1/2}K$ shell electron wavefunction. The measured directional correlation coefficients were consistent with (4^{+4}_{-2})% $d_{3/2}'$ and (44 ± 24)% $d_{5/2}'$ waves in the $1s_{1/2}K$ shell electron wavefunction during the 177 keV nuclear transition and with (11 ± 10)% $d_{5/2}'$ wave in the $1s_{1/2}K$ shell electron wavefunction during the 198 keV nuclear transition. Eighteen weak gamma-rays previously assigned to ^{169}Yb → ^{169}Tm decay were conclusively shown not to be associated with this decay. (auth)

22796 STUDY OF LEVELS IN ^{154}Sm AND ^{156}Gd BY THE (n,n'γ) REACTION USING A NEW SMALL SAMPLE METHOD. Elbakr, S. A. O. Edmonton, Alberta; Univ. of Alberta (1972). 97p.

Thesis.

A technique was developed which makes it possible to study (n,n'γ) reactions using very small scattering samples in close geometry. To show that reliable γ-ray yield curves can be obtained with this method, the excitation curve for the 847 keV γ-ray from ^{56}Fe was measured and was in good agreement with previous measurements. The method was applied to the study of levels above 900 keV in ^{154}Sm and ^{156}Gd populated by the (n,n'γ) reaction. De-excitation γ-rays were observed at several neutron energies between 0.9 and 2.3 MeV. The γ-ray production cross sections were obtained at these neutron energies and were used to determine neutron inelastic scattering cross sections for reactions leading to several states in these nuclei. The experimental results were compared with the predictions of the sta-

tistical theory to establish level spins. Reduced transition probability ratios for γ-rays depopulating members of rotational bands observed in ^{154}Sm and ^{160}Gd were compared to the predictions of the Bohr–Mottelson collective model indicating that these nuclei are good rotors. The ^{7}Li(p,n)^{7}Be reaction was used as a neutron source. A systematic measurement of absolute differential cross section as a function of both energy and angle for the ^{7}Li(p,n$_0$)^{7}Be and ^{7}Li(p,n$_1$)^{7}Be reactions was carried out at proton energies from 2.60 to 5.40 MeV and laboratory angles between 0° and 150°. (CA)

22797 SYNTHESIS OF VERY HEAVY ELEMENTS IN SUPERMASSIVE STARS. Ohnishi, T. (Kyoto Univ., Uji, Japan). Progr. Theor. Phys. (Kyoto); 51: No. 1, 123-133(Jan 1974).

The synthetic processes of very heavy elements taking place in a supermassive star expanding from a very high temperature are investigated. Since the temperature is exceedingly high and the proton mass fraction is much larger than the mass fractions of free neutrons or heavy elements, p-process-like nuclear reactions would occur and the proton-rich heavy nuclides in the mass region $150 \lesssim A \lesssim 215$ may be produced in this type of stars. The mass fractions in the expanding shell in the regions $100 \lesssim A \lesssim 150$, $150 \lesssim A \lesssim 210$ and $210 \lesssim A \lesssim 215$ are, respectively, $10^{-15\sim-16}\xi$, $10^{-10\sim-12}\xi$ and $10^{-8\sim-10}\xi$, where ξ is a parameter presumably being around unity. If the mixing mechanisms of elements have not effectively operated in the universe or in the Galaxy, we can anticipate finding the stars or stellar systems possessing the anomalously high abundances of very heavy elements in $A \gtrsim 150$. (auth)

22798 ATOMIC MASS DIFFERENCES AND NUCLEON SEPARATION AND PAIRING ENERGIES, $Z = 60 \rightarrow 72$. Meredith, J. O. Winnipeg, Manitoba; Univ. of Manitoba (1971). 148p.

Thesis.

A high-resolution double focusing mass spectrometer has been constructed with a working resolving power of 100,000 at the base of the peaks. The spacings of 25 mass spectral doublets, with a typical precision of 5 parts in 10^9, are reported. A method of peak matching using a digital computer has been developed. The spacings of 13 of the above doublets have been determined using this new technique. The resulting mass differences are combined with precise atomic masses and nuclear reaction and decay Q-values in two overlapping adjustments to obtain least squares adjusted masses for $59 \leq Z \leq 72$. The quantities S_{2n}, S_n, P_n, S_{2p}, S_p, P_p, $Q(\beta^-)$ and $Q(\alpha)$ are calculated for each nuclide wherever possible, and their systematic variations are commented upon. (auth)

22799 STRUCTURE OF THE GIANT DIPOLE RESONANCE OF THE NUCLEI ^{166}Er AND ^{178}Hf. Goryachev, B. I.; Kuznetsov, Yu. V.; Orlin, V. N.; Pozhidaeva, N. A.; Shevchenko, V. G. (Moscow State Univ.). JETP Lett. (USSR) (Engl. Transl.); 19: No. 1, 41-43(5 Jan 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 19: No. 1, 65-68(5 Jan 1974).

The cross sections σ_γ for the absorption of γ quanta by the nuclei ^{166}Er and ^{178}Hf were measured. These cross sections have an intermediate structure that can be interpreted in the spirit of the dynamic collective model of giant resonance. (auth)

22800 VOLUME CONSERVING PAIRING IN RARE EARTH NUCLEI. Balbutsev, E. B. (Joint Inst. for Nuclear Research, Dubna, USSR); Bochnacki, Z. Acta Phys. Pol., B; B5: No. 3, 397-405(1974).

Equilibrium pairing in the deformed rare earth nuclei is calculated by varying the energy expression along the trajectory of the constant mean square radius. The Nilsson potential is used in the calculations, and its parameters are the only input data for the problem. The resulting equilibrium values of the proton and neutron energy gaps are compared with the values obtained by the standard procedure of fitting the pairing strength to the experimental odd–even mass differences. (2 figures) (auth)

22801 STUDIES OF THE COLLECTIVE PROPERTIES OF ^{154}Gd AND ^{156}Gd AND SEARCH FOR WEAK TRANSITIONS IN ^{108}Ag AND ^{125}Sb. Gupta, J. B. D. Nashville; Vanderbilt University Microfilms Order No. 74-16,154.

Thesis (Ph. D.).

The decay properties of ^{154}Gd were studied through the measurement of relative intensities of gamma rays, the use of coincidence methods, and by determining the multipolarities of the radiation by directional correlation technique. As a result of these studies, 29 new cascade relationships of weak-intensity transitions in the decay of ^{154}Gd were established. Closely lying doublets were resolved. Information on some intraband and interband transitions was added in this region. A search for weak intensity transitions in the decay of ^{108m}Ag and ^{125}Sb was made; some weak intensity γ rays were established, and limits were placed on doubtful transitions. Usefulness of ^{125}Sb as a reference standard in the low-energy region was pointed out. Directional correlation coefficients for a large number of transitions from the decay of ^{154}Eu were determined. The possibility of explaining the anomalous B(E2) branching ratios from the beta band through the existence of large M1 admixture was not borne out by this study. The E2/M1 and E1/M2 admixture ratios for these transitions were established with reduced errors. Theoretical calculations with pairing plus quadrupole model using Kumar–Baranger theory were made to explore the properties of the beta bands in ^{154}Gd and ^{156}Gd and of the second $K^\pi = 0^+$ bands. Many electromagnetic quantities were derived and compared with experimental values. This study showed the limitations of the phenomenological theory in the band-mixing model of Bohr and Mottelson. The pairing plus quadrupole model with anharmonic vibration and time-dependent approach in which dependence on deformation parameters β and γ is allowed is capable of predicting a large number of properties of these nuclei, including the properties of the beta and second $K^\pi = 0^+$ band. (RWR)

22802 SPECTROSCOPIC DETERMINATION OF THE NUCLEAR MOMENTS OF ^{169}Yb: RELATIVE ISOTOPE SHIFT BETWEEN THE ISOTOPES ^{168}Yb, ^{169}Yb, AND ^{170}Yb. Chapeau, R. J. (National Center of Scientific Research, Orsay, France); Michel, J. J.; Walther, H. J. Phys., B (London); 7: No. 8, L262-L265 (1 Jun 1974).

The nuclear spin, the nuclear magnetic dipole and electric quadrupole moments of the radioactive ^{169}Yb isotope have been determined by measuring the hyperfine splitting for the line $\lambda = 5556$ Å ($4f^{14}6s6p\ ^3P_1 \rightarrow 4f^{14}6s^2\ ^1S_0$) of Yb I. The results are: $I = 1/2$; $\mu = (-0.63 \pm 0.02)\ \mu_N$; $Q = (4.1 \pm 0.06)$ barns. The relative isotope shift between the isotopes ^{168}Yb, ^{169}Yb and ^{170}Yb is found to be: $\delta\sigma(^{168}\text{Yb} - {}^{169}\text{Yb})/\delta\sigma(^{168}\text{Yb} - {}^{170}\text{Yb}) = 0.44 \pm 0.01$. (auth)

22803 SPIN DETERMINATIONS IN LOW LYING STATES OF ^{151}Sm. Singh, B.; Johns, M. W. (McMaster Univ., Hamilton, Ont.). Can. J. Phys.; 52: No. 13, 1160-1166(1 Jul 1974).

Gamma–gamma directional correlation measurements together with parity assignments based on the published literature have been used to make the following J^π assignments in ^{151}Sm: $J^\pi = 3/2^+$ for the 307, 345, 521, 741, 823, and 953 keV states, $J^\pi = 5/2^+$ for the 167, 396, and 446 keV states, and $J^\pi = 7/2^+$ for the 324 keV state. In addition, somewhat less secure assignments of $3/2^-$, $7/2^-$, $5/2^+$ (or $3/2^+$), and $5/2^+$ have been made to the 105, 209, 774, and 878 keV states, respectively. The multipole mixing ratios of the 65, 66, 70, and 105 keV transitions are negative, and the observed values of δ are compared with $|\delta|$ values obtained from L subshell conversion measurements. (auth)

22804 PRE-EQUILIBRIUM EMISSION IN (n,α) AND (p,α) REACTIONS. Caplar, R.; Kulisic, P. (Ruder Boskovic Inst., Zagreb). Fizika (Zagreb); 6: No. 1, 41-49(May 1974).

The mechanism of α-particle emission in (n,α) and (p,α) reactions on heavy and medium-heavy nuclei was considered from the point of view of the pre-equilibrium model as modified by Ribansky and Obložinsky. The introduction of this correction improves the agreement between the model and experimental data. However, part of the reaction yield, depending on the incident energy and the target mass, should be attributed to the emission of preformed α particles. (3 figures, 1 table) (auth)

22805 COMPILATION OF INFINITE DILUTION RESONANCE INTEGRALS. II. Van der Linden, R.; Corte, F. D.; Hoste, J. (Univ., Ghent). J. Radioanal. Chem.; 20: No. 2, 695-706(1974).

The list of resonance integrals is completed with 63 values for (n,γ) reactions, mainly from the second part of the periodic system. The resonance integral for (n,fission) of ^{235}U is included as well as thermal and epithermal self-shielding curves for the elements Sm, Eu, Gd, Dy, and Cd. (auth)

22806 NUCLEAR SPECTROSCOPY OF ^{160}Dy, ^{163}Er, AND ^{183}W. Radzhapov, P. S.; Sabirov, Kh. S. (Inst. of Nuclear Physics, Tashkent). Dokl. Akad. Nauk Uzb. SSR; No. 7, 28-29(1973). (In Russian).

The results of determinations of angular correlations of a series of gamma cascades in ^{160}Dy, ^{163}Er, and ^{183}W and of lifetimes of the 1399- and 1358-keV levels in ^{160}Dy and of the 264- and 80-keV levels in ^{163}Er are presented. (TTT)

22807 DETERMINATION OF NUCLEAR GROUND STATE PROPERTIES FAR FROM STABILITY BY OPTICAL PUMPING. Otten, E. W. (Univ., Mainz). J. Phys. (Paris), Colloq.; No. 4, 63-68(1973).

From Centenary congress on the French Physical Society; Vittel, France (28 May 1973).

The possibilities of determining nuclear spin, moments and variation in charge volume by optical pumping of on-line-mass-separated isotopes are described for the example of the isotopic chain ^{181}Hg–^{205}Hg. The variation in nuclear charge volume ($\delta\langle r^2\rangle$) along this chain and, in particular, its abrupt change for the lightest Hg isotopes (indicating a phase transition in nuclear structure) are discussed. (FR)

22808 HARTREE–FOCK CALCULATIONS FOR NUCLEAR DEFORMATIONS AND FISSION BARRIERS. Quentin, P. (Paris Univ., Orsay, France). J. Phys. (Paris), Colloq.; No. 4, 101-129 (1973). (In French).

From Centenary congress on the French Physical Society; Vittel, France (28 May 1973).

Methods and results of deformed Hartree–Fock calculations are discussed here, especially for medium and heavy nuclei (A > 100), where important progress has been recently achieved. The choice of a suitable effective interaction is of crucial importance for the possibility and the success of such calculations. One has to find some parametrization–simple, but having a real physical basis. That is the case of the Skyrme interaction, which describes spherical nuclei in an excellent way, and is shown here to provide very good results in various nuclear deformation regions as s–d shell, rare-earths, transition regions before and after rare-earths, actinides. Results of ground-state calculations and deformation energy curves (obtained with the constrained Hartree–Fock technique) are systematically discussed after a short presentation of relevant techniques and approximations. (FR)

Nuclear Properties and Reactions, 190 ≤ A ≤ 219

Refer also to abstracts 22243, 22584, 22629, 22649, 22652, 22659, 22682, 22686, 22704, 22763, 22773, 22776, 22778, 22793, 22794, 22797, 22804, 22805, 22807, 22839, 22845, 22847, 22859, 22871, and 22875.

22809 (AECL-4773) PHYSICS DIVISION PROGRESS REPORT, 1 JANUARY TO 31 MARCH, 1974. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). May 1974. 94p. (PR-P-101). Dep. NTIS (U. S. Sales Only) $7.75. AECL $2.00.

Studies by the Nuclear Physics Branch included the yield from the ^{3}He(^{3}He,n) reaction, isobaric mass differences in the A = 40 ± 14 region, back-angle electron scattering from Au, and γ decay of neutron resonances in Tl; a report on operation of the tandem is also given. Work with high-purity planar Ge detectors continued. Solid-state and applied studies and computation were also performed; included among the latter are the following: re-wetting time of a reactor fuel element after LOCA, fuel modeling, friction factors in turbulent flow in rough pipes, two-phase fluid flow and the creep of irradiated material, and the dynamics of a single tower of the Bruce Heavy Water Plant. One paper in this report was title listed separately. (RWR)

22810 (COO-2167-3, pp 66-71) HIGH ANGULAR MOMENTUM STATES IN THE LEAD ISOTOPES. Tickle, R. S.; Gray, W. S.; Parkinson, W. C. 1974.

In Cyclotron Laboratory annual report, June 15, 1973–June 15, 1974.

22811 (COO-3496-44, pp 77-84) ENERGY DEPENDENCE OF Γ_f/Γ_n FOR THE NUCLEUS ^{216}Rn. Freiesleben, H. (Univ., Marburg, Ger.); Britt, H. C.; Huizenga, J. R. 1974.

In studies of nuclear fission, low-energy nuclear reactions and transuranic nuclei.

22812 (COO-3496-44, pp 97-107) LITHIUM ION INDUCED REACTIONS ON ^{209}Bi. Freiesleben, H. (Univ., Marburg, Ger.); Britt, H. C.; Birkelund, J. R.; Huizenga, J. R. 1974.

In studies of nuclear fission, low-energy nuclear reactions and transuranic nuclei.

22813 (COO-3496-44, pp 108-113) GRAZING ANGLES, REACTION CROSS SECTIONS, AND FISSION FRAGMENT SYMMETRY ANGLES FOR ^{40}Ar AND ^{84}Kr INDUCED REACTIONS ON HEAVY TARGETS. Huizenga, J. R.; Birkelund, J. 1974.

In studies of nuclear fission, low-energy nuclear reactions and transuranic nuclei.

22814 (COO-3496-44, pp 128-144) VALIDITY OF THE INTERACTION POTENTIAL FOR VERY HEAVY ION REACTIONS. Huizenga, J. R.; Freiesleben, H. 1974.

In studies of nuclear fission, low-energy nuclear reactions and transuranic nuclei.

22815 (JAERI-M-5418) NEUTRON SCATTERING FROM ^{207}Pb. Tomita, Y.; Tanaka, S.; Maruyama, M. (Japan Atomic Energy Research Inst., Tokyo). Oct 1973. 9p. INIS.

The elastic and inelastic scattering of neutrons by ^{207}Pb was investigated. Excitation functions were measured in the energy range 1.37–3.56 MeV. No distinct intermediate structure was observed. Angular distributions were measured at five energies between 1.47 and 3.56 MeV. The results were analyzed by the optical model and Moldauer's theory, and values of optical-potential parameters were obtained. (auth)

22816 (LUNP-7310) CALCULATION OF FISSION–SPALLATION COMPETITION FOR PHOTONS AS INCIDENT PARTICLES. Schroeder, B.; Andersson, G.; Forkman, B. (Lund Univ. (Sweden). Fysiska Institutionen). Sep 1973. 54p. Dep. NTIS (U. S. Sales Only) $5.75.

A calculation of fission–spallation competition for monoenergetic photons of energies between 100 to 500 MeV incident on ^{197}Au and ^{238}U is presented. The cascade part of the calculation is described briefly, and the momentum distributions of cascade nuclei are discussed. Contrary to what is found for protons as incident particles, no simple relation between the imparted excitation energy and the forward component of the momentum exists for the case of photons as incident particles. In the evaporation part of the calculation four free parameters are used; their values are determined from experimental photon–nucleus interaction data, except for the fission barriers, the values of which were taken from data in the literature. Energy shell corrections were applied to the fission barriers and in the case of heavy elements (charge numbers larger than 87) the barriers were divided into two parts, i.e., a symmetric and an asymmetric fission barrier for each nucleus. In the calculations, detailed information concerning the distributions of mass, charge, excitation energy and momentum components was obtained for different groups of nuclei, e.g. all cascade nuclei, cascade residuals leading to fission, fissioning nuclei and evaporation residuals. It turns out that almost all existing experimental data about photofission in the elements ^{197}Au and ^{238}U may be reproduced from the distributions obtained in the present calculations. The fissility in the case of ^{197}Au is found to depend on the ratio Z^2/A for cascade residuals and also on the excitation energy of these residuals. The step in the evaporation chain at which fission occurs depends strongly on the excitation energy of the cascade nuclei leading to the particular fission event considered. (auth)

22817 (NP-20044, pp 32-36) STUDY OF TRANSFER REACTIONS INDUCED BY ^{14}N AND ^{12}C ON ^{206}Pb AND ^{209}Bi. Motobayashi, T.; Kohno, I.; Nakajima, S.; Yoshie, M.; Katori, K.; Mikumo, T.; Kamitsubo, H. Dec 1973.

22818 (NP-20044, pp 37-38) ANGULAR DISTRIBUTIONS AND LINEAR MOMENTUM TRANSFERS OF TARGET RESIDUE IN THE ^{209}Bi + ^{12}C REACTION. Hiruta, K.; Nomura, T.; Yoshie, M.; Hashimoto, O. Dec 1973.

22819 (NP-20044, pp 71-73) MAGNETIC MOMENT OF THE $^{29}/_{2}^{+}$ STATE IN ^{213}Fr. Recknagel, E.; Yamazaki, Y.; Hashimoto, O.; Nagamiya, S.; Nakai, K. Dec 1973.

22820 (NP-20044, pp 74-76) BLOCKING EFFECT OF THE M1 CORE POLARIZATION STUDIED FROM THE g-FACTOR OF THE $(\pi h_{9})^{6}$ 8^{+} STATE IN ^{214}Ra. Yamazaki, Y.; Hashimoto, O.; Ikezoe, H.; Nagamiya, S.; Nakai, K.; Yamazaki, T. Dec 1973.

22821 (NP-20044, pp 77-78) IN-BEAM ALPHA- AND GAMMA-SPECTROSCOPY OF ^{216}Ra. Nomura, T.; Hiruta, K.; Yoshie, M.; Hashimoto, O. Dec 1973.

22822 SEMIDIRECT CAPTURE OF NEUTRONS. Bergqvist, I. (Univ. of Lund, Sweden). Nukleonika; 19: No. 5, 411-424 (1974).

Some aspects of the experimental and theoretical situation on the radiative capture of the giant resonance are discussed. The validity of the semidirect capture model is tested. (auth)

22823 NEW NEUTRON-DEFICIENT Pb AND Bi NUCLIDES PRODUCED IN CROSS BOMBARDMENTS WITH HEAVY IONS. Le Beyec, Y. (Institut de Physique Nucleaire, Orsay, France); Lefort, M.; Livet, J.; Porile, N. T.; Silvola, A. Phys. Rev., C; 9: No. 3, 1091-1102(Mar 1974).

New α-emitting bismuth nuclides ranging in mass number from 189 to 197 and lead nuclides ranging from 186 to 192 were produced in the following reactions: ^{203}Tl(^{3}He,xn)$^{206-x}$Bi, ^{187}Re(^{16}O,xn)$^{205-x}$Bi, ^{185}Re(^{16}O,xn)$^{203-x}$Bi, ^{181}Ta(^{20}Ne,xn)$^{201-x}$Bi, ^{159}Tb(^{40}Ar,xn)$^{199-x}$Bi, ^{181}Ta(^{19}F,xn)$^{200-x}$Pb, ^{182}W(^{16}O,xn)$^{198-x}$Pb, and ^{155}Gd(^{40}Ar,xn)$^{195-x}$Pb.

Assignments were made on the basis of excitation function measurements and comparison with similar reactions leading to the formation of the analogous well-known Po nuclides. The following assignments were made, where for each nuclide the two listed numbers are the α-ray energy in MeV and the half-life: ^{197m}Bi–5.77, 10 min; ^{195}Bi–5.43, 170 s; ^{195m}Bi–6.11, 90 s; ^{194}Bi–5.61, 105 s; ^{193}Bi–5.90, 64 s; ^{193m}Bi–6.18; ^{192}Bi–6.06, 42 s; ^{191}Bi–6.32, 13 s; ^{191m}Bi–6.63; ^{191m}Bi–6.86; ^{190}Bi–6.45, 5.4 s; ^{189}Bi–6.67, <2 s; ^{192}Pb–5.06, 2.3 min; ^{191}Pb–5.29, 1.3 min; ^{190}Pb–5.58, 1.2 min; ^{189}Pb–5.72, 51 s; ^{188}Pb–5.98, 26 s; ^{187}Pb–6.08, 17 s; and ^{186}Pb–6.32, 8 s. Estimates of α branching ratios are also presented. (11 figures, 5 tables) (auth)

22824 ELASTIC ELECTRON SCATTERING AND THE NUCLEAR MAGNETIZATION DISTRIBUTION. Prewitt, J. F. (Dikewood Corp., Albuquerque, NM); Wright, L. E. Phys. Rev., C; 9: No. 5, 2033-2045(May 1974).

An analysis of elastic electron scattering from the nuclear charge and magnetization distributions is carried out with phase-shift analysis and distorted-wave Born approximation, respectively. It is found that magnetic electron scattering should be measurable from medium and heavy odd-A nuclei at normal scattering angles in addition to 180°. In particular, the scattering from the maximally allowed magnetic multipole distribution should be easily observed. (7 figures) (auth)

22825 GIANT M1 RESONANCE IN ^{207}Pb. Medsker, L. R.; Jackson, H. E. (Argonne National Lab., IL). Phys. Rev., C; 9: No. 2, 709-716(Feb 1974).

The ^{207}Pb(γ,n) reaction has been studied with high-energy resolution and photon intensity to determine radiation widths, spins, and parities of resonances. The present data show an intense p-wave strength. A comparison between the measured and calculated integrated M1 strength suggests the existence of a giant M1 resonance in ^{207}Pb. The distribution of p-wave resonances suggests an envelope of M1 strength centered at $E_n \approx 700$ keV. No evidence was found for the photon doorway in ^{207}Pb(γ,n) proposed in earlier studies. This state had been interpreted as a common doorway occurring in both the photon and neutron channels. (auth)

22826 ^{207}Pb(p,d)^{206}Pb REACTION AND SOME MATRIX ELEMENTS OF THE EFFECTIVE INTERACTION. Lanford, W. A.; Crawley, G. M. (Michigan State Univ., East Lansing). Phys. Rev., C; 9: No. 2, 646-659(Feb 1974).

The cross sections for the ^{207}Pb(p,d)^{206}Pb reaction have been measured relative to the cross sections for the ^{208}Pb(p,d)^{207}Pb reaction to the single-neutron-hole states in ^{207}Pb. The reactions were studied with 35-MeV protons and a final deuteron resolution of 5 keV (full width at half maximum). By making the same assumptions as are usually made in model calculations of ^{206}Pb, the matrix elements of the effective interaction of a $p_{\frac{1}{2}}$ neutron with neutrons in other orbits are derived from the experimental results. (auth)

22827 K-SHELL AUTOIONIZATION IN THE BETA DECAY OF ^{204}Tl. Ljubicic, A.; (Inst. Rudjer Boskovic, Zagreb); Martel, D.; Jones, R. T.; Logan, B. A. Can. J. Phys.; 52: No. 13, 1152-1154 (1 Jul 1974).

The K-shell autoionization occurring in the β decay of ^{204}Tl has been measured to be $(1.18 \pm 0.06) \times 10^{-4}$ K-shell vacancies per emitted β particle. The result is in agreement with a recent theoretical prediction. (auth)

22828 RADIATIVE NEUTRON CAPTURE STUDY OF ^{203}Tl. Colenbrander, A. J.; Kennett, T. J. (McMaster Univ., Hamilton, Ont.). Can. J. Phys.; 52: No. 13, 1215-1227(1 Jun 1974).

The results of a high-sensitivity study of the ^{203}Tl(n,γ)^{204}Tl reaction are reported. Attention was focussed upon the detection of low-intensity components and the establishment of the absolute intensity for the observed transitions. A technique for deconvolving the spectrum was employed which allows one to transform each spectral component into a simple Gaussian response and thereby to obtain a true representation of the gross spectral shape. The marked deviation of the spectrum from that expected using a simple statistical model is clearly revealed. The neutron separation energy was found to be 6655.8 ± 0.3 keV for ^{204}Tl and 6503.4 ± 0.4 keV for ^{206}Tl. (auth)

22829 FAST NEUTRON CAPTURE IN Tl, Hg, Au, AND Ta AND GAMMA RAY STRENGTH FUNCTIONS. Earle, E. D. (Atomic Energy of Canada Ltd., Chalk River, Ont.); Lone, M. A.; Bartholomew, G. A.; McDonald, W. J.; Bray, K. H.; Moss, G. A.; Meilson, G. C. Can. J. Phys.; 52: No. 11, 989-998(1 Jun 1974).

Gamma ray spectra following the capture of 0.7, 1.7, and 2.6 MeV neutrons in Tl and Hg, of 0.7 and 2.6 MeV neutrons in Ta, and of 2.6 MeV neutrons in Au were measured with a NaI detector. The spectral distributions were obtained by unfolding the detector response function, and γ-ray strength functions were deduced for Tl, Au, and Ta by a spectrum fitting method. The strength functions in Tl and Au, when compared with the Lorentzian predictions, show a strong decrease below ~5 MeV and in Tl there is a resonance-like structure at ~5.5 MeV. No such structure is found in the strength function for Ta. This behavior is qualitatively interpreted in terms of recent particle–hole calculations. (auth)

22830 HALF-LIFE AND THE α-DECAY BRANCHING RATIO OF ^{207}Po. Parsa, B.; Markowitz, S. S. (California Univ., Berkeley). J. Inorg. Nucl. Chem.; 36: No. 7, 1429-1431(Jul 1974).

^{207}Po was produced via ^{3}He activation of lead samples. Polonium was chemically separated from the irradiated targets. Gamma and α spectra were measured with Ge(Li) and surface-barrier α counters, respectively. The decay of the 992-keV γ-ray of ^{207}Po was followed and a half-life of 5.84 ± 0.07 hr was obtained for ^{207}Po. The α-decay branching of ^{207}Po was measured to be 0.0210 ± 0.0023 per cent. (auth)

22831 ^{203}Tl(γ,γ') REACTION BY 6419 keV NEUTRON CAPTURE GAMMA-RAYS. Alberini, R.; Oliva, P. R.; Prosperi, D. (CNEN, Rome). Lett. Nuovo Cim.; 10: No. 16, 726-732(17 Aug 1974).

The gamma spectrum from this reaction is plotted and tabulated. A decay scheme of the 6419.0-keV level is shown, along with branching ratios for the transitions. Spin–parity assignments and transition multipolarities are discussed for some of the levels. (3 figures, 1 table) (RWR)

22832 HIGH-ENERGY HEAVY IONS: A NEW AREA FOR PHYSICS RESEARCH. Heckman, H. H. (Univ. of California, Berkeley). pp 403-415 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973). See CONF-730642-.

Emerging from the first heavy ion experiments at the Bevatron are preliminary results that reveal high-energy heavy ion research to be a promising and stimulating new area of physics research, pertinent to elementary particles, nuclear structure, and cosmic rays. Among the heavy ion physics experiments in progress at the Bevatron are studies on the fragmentation of projectile and target nuclei, coherent pion production and the production and detection of high-energy hypernuclei. The experiments on the fragmentation of beam nuclei at 1.05 and 2.1 GeV/nucleon have shown specific relevance to contemporary theory on inclusive reactions, particularly to the concept of factorization, i.e., the modes of fragmentation of beam nuclei are independent of the target nucleus. Complementary experiments on the fragmentation of target nuclei are concerned with the characteristic differences between the production of light and heavy fragments from heavy element targets under bombardment by p, ^{12}C, and ^{16}O beams at 2.1 GeV/nucleon. The investigation on the feasibility of producing high-energy hyperfragments, via the two-body reaction $^{A}Z + p \rightarrow {}^{A+1}Z_A + K^+$, where the target proton and heavy ion projectile become, respectively, a K^+ and a high velocity hyperfragment, may lead to a new technique in the field of hypernuclear physics. (auth)

Nuclear Properties and Reactions, A ≥ 220

Refer also to abstracts 21931, 22633, 22663, 22767, 22770, 22778, 22793, 22805, 22808, 22813, 22814, 22816, and 22832.

22833 (COO-3496-44) STUDIES OF NUCLEAR FISSION, LOW-ENERGY NUCLEAR REACTIONS AND TRANSURANIC NUCLEI. Progress Report, June 1, 1973–June 1, 1974. Huizenga, J. R. (Rochester Univ., N. Y. (USA). Dept. of Chemistry). 1974. Contract AT(11-1)-3496. 175p. Dep. NTIS $11.75.

During this past year the research program included studies of direct reactions, compound-nucleus and statistical reactions, nuclear fission, heavy-ion reactions, and the effect of pressure on radioactive decay constants. The direct-reaction experiments emphasized collective and single-particle levels in actinide nuclei. A level density formula including low-energy rotational levels for deformed nuclei was derived and tested with neutron resonance data for lanthanide and actinide nuclei. The energy dependence of the ratio of the fission to neutron emission width of ^{216}Rn was measured and fitted with a theory where the level density of the highly deformed saddle configuration contains an enhancement due to collective rotations. A number of lithium-ion-induced reactions were studied. One interesting feature of

these reactions is their large transfer cross section relative to the compound-nucleus cross section. Experiments were also performed with ^{40}Ar and ^{84}Kr projectiles on heavy targets. Krypton-induced reactions show striking new features. Finally, work dealing with the effect of pressure on electron decay constants is reported. (28 figures, 21 tables) (auth)

For title listings of individual papers see: 22610, 22664, 22773, 22811–22814, 22834–22839, and 22872–22875.

22834 (COO-3496, pp 3-13) LEVELS OF ^{233}Pa EXCITED IN HELIUM-INDUCED SINGLE-PROTON TRANSFER REACTIONS. Elze, T. W. (Univ., Frankfurt am Main); Huizenga, J. R. 1974.

In studies of nuclear fission, low-energy nuclear reactions and transuranic nuclei.

22835 (COO-3496-44, pp 14-26) COLLECTIVE LEVELS POPULATED BY THE ^{230}Th(d,d'), ^{240}Pu(d,d'), AND ^{244}Pu(d,d') REACTIONS. Thompson, R. C.; Huizenga, J. R.; Elze, T. W.; Unik, J. P. 1974.

In studies of nuclear fission, low-energy nuclear reactions and transuranic nuclei.

22836 (COO-3496-44, pp 56-61) ELASTIC SCATTERING OF α PARTICLES FROM ^{238}U. Freiesleben, H. (Univ., Marburg, Ger.); Huizenga, J. R. 1974.

In studies of nuclear fission, low-energy nuclear reactions and transuranic nuclei.

22837 (COO-3496-44, pp 62-70) TOTAL REACTION CROSS SECTIONS OF DEFORMED NUCLEI: A STUDY OF THE ^{233,236}U + α SYSTEMS. Freiesleben, H. (Univ., Marburg, Ger.); Huizenga, J. R. 1974.

In studies of nuclear fission, low-energy nuclear reactions and transuranic nuclei.

22838 (COO-3496-44, pp 85-91) ^{6,7}Li INDUCED FISSION OF ^{232}Th AND ^{238}U. Freiesleben, H. (Univ., Marburg, Ger.); Huizenga, J. R. 1974.

In studies of nuclear fission, low-energy nuclear reactions and transuranic nuclei.

22839 (COO-3496-44, pp 114-118) COMPARISON OF EXPERIMENTAL VALUES OF THE CRITICAL ANGULAR MOMENTUM FOR ^{40}Ar AND ^{84}Kr INDUCED REACTIONS WITH THE PREDICTIONS OF THE WILCZYNSKI AND BASS MODELS. Huizenga, J. R. 1974.

In studies of nuclear fission, low-energy nuclear reactions and transuranic nuclei.

22840 (IKF-32, pp 12-13) STUDY OF THE STATES OF ^{233}Pa BY MEANS OF PROTON-TRANSFER REACTIONS. Elze, T. W.; Huizenga, J. R. 1973. (In German).

22841 (INIS-MF-1168-2, pp vp, 5p) SYNTHESIS OF TRANSFERMIUM AND THE STUDY OF THEIR RADIOACTIVE AND CHEMICAL PROPERTIES. Druin, V. A. (Joint Inst. for Nuclear Research, Dubna, USSR). 1973.

From Finnish summer school in nuclear physics; Liperi, Finland (11 Jun 1973).

Research on the production of new elements including the development of methods for the synthesis and identification and the study of both alpha radioactive and spontaneously fissioning isotopes is outlined. (JFP)

22842 (INIS-MF-1168-2, pp vp, 12p) EXPERIMENTS ON THE PRODUCTION OF SUPERHEAVY ELEMENTS. Lobanov, Yu. V. (Joint Inst. for Nuclear Research, Dubna, USSR). 1973.

From Finnish summer school in nuclear physics; Liperi, Finland (11 Jun 1973).

A lecture is given on methods of producing superheavy elements in nuclear reactions of fission and fusion. (JFP)

22843 (JAERI-M-5536) ESTIMATE OF UNCERTAINTIES IN THE EXPERIMENTAL DATA OF ^{235}U(n,f), ^{239}Pu(n,f), AND ^{238}U(n,γ) CROSS SECTIONS. Hasegawa, A.; Katsuragi, S. (Japan Atomic Energy Research Inst., Tokyo). Jan 1974. 43p. (In Japanese). NTIS (U. S. Sales Only).

In order to obtain a better interpretation of integral experiments, we need an accurate group cross section set. Therefore, recently, strategies for evaluating cross sections have been widely studied. In this connection, it becomes more important for evaluators to know errors in measured cross sections. In this study, we examined the distribution of experimental cross section data of ^{235}U(n,f), ^{239}Pu(n,f) and ^{238}U(n,γ) in the important energy range for fast reactors, in order to see the current uncertainties of these data. In this analysis we used the experimental data in NEUDADA file at CEA Saclay. The following results were obtained for the guide value of cross section deviations in order to use them in cross section adjustment work: ^{235}U(n,f): 50 keV ~ 1 MeV, ±7% (100 keV ~ 200 keV ± 4%), 1 keV ~ 50 keV, ±30 ~ 10%; ^{239}Pu(n,f): 100 keV ~ 1 MeV, ±4 ~ 5%, 1 keV ~ 100 keV, ±30 ~ 10%; ^{238}U(n,γ): 10 keV ~ 1 MeV, ±13 ~ 17%, 1 keV ~ 10 keV, ±30 ~ 16%. (auth)

22844 (JINR-D7-8099) SYNTHESIS OF NEUTRON-DEFICIENT ISOTOPES OF FERMIUM, KURCHATOVIUM AND ELEMENT WITH ATOMIC NUMBER 106. Oganesyan, Yu. Ts.; Tret'yakov, Yu. P.; Il'inov, A. S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1974. 15p. Dep. NTIS (US Sales Only) $4.00.

A new possibility for synthesis of heavy elements with atomic numbers greater than 100 in nuclear reactions is considered, in which the "magic" nucleus of Pb and its neighbors are bombarded by ions with masses greater than 40 amu. The reactions ^{206,207,208}Pb(^{40}Ar,xn)^{244,245}Fm may be considered as examples; the greatest cross sections occur for emission of only a small number of neutrons (x = 2 or 3). By applying this method to the reaction Pb + ^{50}Ti, new isotopes of the element 104 were synthesized. In the reactions ^{207,208}Pb + ^{54}Cr there was synthesized a new spontaneously fissioning isotope with a half-life of several milliseconds. From the experimental results it was possible to propose that this observation was due to the decay of an element with atomic number 106. (2 figures, 1 table) (tr-auth)

22845 (KHFTI-73-9, pp 13-17) STUDY OF ^{238}U AND ^{209}Bi FISSION BY PROTONS WITH ENERGY E_p = 1 GeV. Kotov, A. A.; Semenchuk, G. G.; Bochagov, B. A.; Gorshkov, B. L.; Kovshevnyi, G. G.; Solyakin, G. E. (Inst. of Nuclear Physics, Leningrad). 1973. (In Russian).

The first results of the study of the fission of ^{238}U and ^{209}Bi using portable semiconductor detectors were reported. The angular correlations of the fission fragments were measured as a function of the rotation of the detector. The measurement results were used for the determination of the excitation energy. The excitation energies were 142 ± 13 eV for ^{238}U and 223 ± 20 MeV for ^{209}Bi. (tr-auth)

22846 (ORO-4317-40) TRANSITION FROM MASS ASYMMETRY TO SYMMETRY IN THE SPONTANEOUS FISSION OF Fm ISOTOPES. Technical Report No. 75-008. Mustafa, M. G. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). Jul 1974. 14p. Dep. NTIS $4.00.

The observed transition in the spontaneous fission mass distribution from asymmetry in the lighter Fm isotopes to symmetry in the heavier Fm isotopes is examined on the basis of the potential energy surfaces (PES) and fragment shell effects in the two-center shell model. The PES for ^{256}Fm were calculated and compared with previous PES results for other Fm isotopes. The calculations show that the lighter Fm isotopes (up to ^{256}Fm) should fission asymmetrically, while ^{258}Fm and other heavier Fm isotopes should fission symmetrically. The role of fragment shell effects on this transition is shown quantitatively. (5 figures) (auth)

22847 STUDIES OF TERNARY FISSION INDUCED BY HEAVY IONS. Kasner, M. L. Lafayette, IN; Purdue University (1973). 193p. University Microfilms Order No. 74-15,181.

Thesis (Ph. D.).

The excitation function for the formation of ^{28}Mg in the bombardment of ^{197}Au by ^{12}C ions was determined from 70 to 90 MeV. The cross sections ranged from ~0.3 to 1.5 microbarns. The ratio σ(Mg)/σ (total fission) indicated that high angular momentum did not significantly enhance the yields of the ternary fission products. The mass-yield distribution for the fission of ^{232}Th induced by 121-MeV ^{12}C ions was constructed by radiochemically measuring the yields of nine light binary and ternary fission products. The high angular momentum brought in by the heavy ion did not significantly enhance the yields of the ternary fission products. Fission track detectors were used to measure the total fission cross sections for ^{12}C + ^{232}Th. The cross sections ranged from 0.35 ± 0.03 barns at 42 MeV of excitation energy to 2.03 ± 0.13 barns at 92.5 MeV. (Diss. Abstr. Int., B)

22848 SOME REMARKS CONCERNING NUCLEAR STRUCTURE EFFECTS IN M1 INTERNAL-CONVERSION PROCESSES IN ODD-A NUCLEI. Krpic, D. K. (Univ., Belgrade); Anicin, I. V. Phys. Rev., C; 9: No. 2, 660-663(Feb 1974).

A method for the effective spin-gyromagnetic-ratio determination within the scope of the Nilsson model for deformed odd-A nuclei using the internal-conversion data is discussed. Besides, the procedure reveals a "hidden penetration effect" in an internal-conversion process. These features are exemplified in the case of the 208-keV transition in the ^{237}Np nucleus. The spin gyromagnetic ratio and the penetration parameter are found to be $g_{s,eff} = 0.65 g_{s,free}$ and λ = 48, respectively. (auth)

22849 NEUTRON-INDUCED FISSION CROSS SECTION OF ^{237}U. McNally, J. H.; Barnes, J. W.; Dropesky, B. J.; Seeger, P. A.; Wolfsberg, K. (Los Alamos Scientific Lab., NM). Phys. Rev., C; 9: No. 2, 717-722(Feb 1974).

An 18.1-μg sample of ^{237}U (half-life 6.70 ± 0.02 day) was prepared and exposed to a neutron beam from the underground nuclear explosion Pommard. The neutron-induced fission cross section was measured from 43 to 1000 eV and from 0.1 to 2 MeV. A resonance analysis was attempted from 43 to 220 eV; resonance areas are reported. Both 0^+ and 1^+ seem to be present, with average spacing 3.5 eV. The cross section at 1 MeV is 1.0 ≠ 0.1 b; from 300–1000 eV, the cross section is 30% of that for ^{239}Pu. (auth)

22850 FURTHER STUDIES OF PAIRING EXCITATIONS IN ACTINIDE NUCLEI: ^{233}U, ^{237}Pu, ^{236}Np, ^{241}Am, ^{224}Ra, AND ^{238}Pu. Friedman, A. M. (Argonne National Lab., IL); Katori, K.; Albright, D.; Schiffer, J. P. Phys. Rev., C; 9: No. 2, 760-766(Feb 1974).

The behavior of a pairing excitation, previously reported in even actinide nuclei, has been explored with two odd-neutron (^{235}U and ^{239}Pu) and two odd-proton (^{237}Np and ^{243}Am) targets as well as the even–even targets ^{226}Ra and ^{240}Pu. It is found that this behavior is similar to that previously found in even–even actinide nuclei. (auth)

22851 GROUND STATE BAND MEMBERS IN ^{236}U AND ^{230}Th STUDIED WITH THE (p,t) REACTION. Takekoshi, E. (Japan Atomic Energy Research Inst., Tokai); Ishizaki, Y.; Orihara, H.; Kanazawa, M.; Kasagi, J. J. Phys. Soc. Jap.; 36: No. 2, 336-340 (Feb 1974).

The (p,t) reaction at E_p = 52 MeV has been used to study differential cross sections and cross section ratios of the ground-state-band members in ^{238}U and ^{230}Th. Experimental results were compared with the usual zero-range DWBA calculations, where the difference between deformations of the target and the residual nucleus was explicitly taken into account. In ^{238}U, angular distributions of 0^+(g. s), 2^+(45 keV), 4^+(149 keV) and 6^+(310 keV) members of ground-state band were obtained. In addition, the 8^+(520 keV) member, which has been assigned from α–γ measurements, was observed. For ^{230}Th, the 0^+(g. s), 2^+(53 keV) and 4^+(174 keV) members of the ground-state band were observed; also, the previously unobserved 6^+ member was found at an excitation energy very near the 400 keV estimated from the I(I + 1) law. (auth)

22852 CALCULATION OF NEUTRON INELASTIC SCATTERING CROSS SECTIONS FOR ^{233}Pa AND ^{239}Np. Miyamoto, K.; Ohta, M.; Ohsawa, T. (Kyushu Univ., Fukuoka). Mem. Fac. Eng., Kyushu Univ.; 33: No. 2, 47-48(Oct 1973).

Neutron inelastic scattering cross sections of ^{233}Pa and ^{239}Np are calculated in the range of neutron energy from 30 keV to 11 MeV. The optical model and Hauser–Feshbach formula are used in the lower energy region, and the evaporation model is used in the higher energy region. Calculations are performed by using the computer code ELIESE-2. Effects of competitive processes, such as neutron capture, fission, (n,2n), etc., are taken into account in the calculations. (auth)

22853 PRESENT STATUS OF THEORETICAL STUDY OF SUPER HEAVY NUCLEI. Takahashi, K. (Waseda Univ., Tokyo). Uchusen Kenkyu; 17: No. 4, 558-561(Feb 1973). (In Japanese).

From symposium on charged particles and cosmic radiation; Hamamatsu, Japan (Dec 1971).

A review on the theoretical study of superheavy nuclei is presented. Stable and quasi-stable nuclei distribute around the Heisenberg's valley in the N–Z plane, and have been found exhaustively, because heavy nuclei fission or disintegrate due to the effect of the large Coulomb force. However, some nuclei around double magic numbers such as ^{208}Pb and a nucleus with Z = 114 and N = 184, may be stable. The calculation of the half-life of fissionable nuclei is very hard, and various approaches have been investigated. Microscopic and macroscopic approaches and the combination of both approaches have been studied. Two possibilities for the formation of superheavy nuclei have been considered, namely, heavy-ion reactions and multiple neutron capture (r-process, nuclear explosions). As an origin, the r-process, due to the explosion of supernovae is suggested; however, it turns out to be denied because of nuclear fission or delayed fission. It is important at present to investigate experimentally. The heavy-ion reaction is also accompanied by theoretical difficulty for the explanation of the formation of superheavy nuclei. The reasons are large excitation energy and deformation of nuclei. Direct transfer reactions and pinch-off reactions are under investigation. (JA)

22854 PROBABILITY OF PROMPT NEUTRON EMISSION FROM SPONTANEOUS FISSION OF ^{240}Pu. Wang, Y. S.; Hsu, C. C. Wu Li Hsueh Pao; 23: No. 1, 38-45(24 Jan 1974). (In Chinese).

The probability distribution of prompt-neutron number from the spontaneous fission of ^{240}Pu was measured by the use of a spherical liquid scintillation detector 60 cm in diameter. The experimental distribution can be well represented by a Gaussian distribution with σ = 1.08. This result was compared with the experimental results of Diven, Hicks, and Boldeman, and is in agreement with the semiempirical theoretical distribution given by Terrel. The absolute efficiency of the detector for the fission neutron of ^{240}Pu was found to be 0.759 ± 0.011, based on the average number of prompt neutrons per fission for spontaneous fission of ^{240}Pu $\bar{\nu}$ = 2.154 ± 0.028. (JPRS)

22855 MULTIPLICITY OF PROMPT NEUTRONS FROM SPONTANEOUS FISSION OF URANIUM-238. Huang, S. N.; Ch'en, C. K.; Han, H. Y. Wu Li Hsueh Pao; 23: No. 1, 46-51 (24 Jan 1974).

The distribution of prompt neutron numbers (P_ν) in the spontaneous fission of uranium-238 was measured by using a cadmium-loaded liquid scintillation detector. The experimental results show that σ_ν, the width of P_ν distribution, is equal to 0.90 ± 0.09, which is smaller than the corresponding values of other even–even heavy nuclei (Pu, Cm, Cf, and Fm). It was found also that the average neutron number $\bar{\nu}$ = 1.96 ± 0.05, which is in agreement with previous experimental results. (JPRS)

22856 STATISTICAL MODEL FOR EXCITATION ENERGY DISTRIBUTIONS IN ACTINIDE FISSION. Facchini, U.; Saetta-Menichella, E. (Centro Informazioni Studi Esperienze, Milan). J. Phys., A (London); 7: No. 8, 975-989(21 May 1974).

The last stage of the fission process has been studied on the basis of a statistical model. Two fundamental hypotheses are made: (i) the internal degrees corresponding to the fragment nuclear structure are in conditions of statistical equilibrium and (ii) the freedom degrees related to the fragment motion at the scission point are not in statistical equilibrium with the internal degrees. The proposed statistical model reproduces the general properties of the excitation energies of the fission fragments in actinide fission. (auth)

22857 FISSION OF ^{239}Pu BY NEGATIVE MUONS. Evseev, V. S.; Mamedov, T. N. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 19: No. 6, 1222-1225(Jun 1974). (In Russian).

The neutron spectrum from the μ capture in ^{239}Pu is measured in the interval 2.4 to 10 MeV. The absolute yield of neutrons Δn per a muon stop (prompt + captured) is determined in the range 2.6 to 8.6 MeV. The known Δn and the mean number of neutrons $\bar{\nu}$ from the ^{239}Pu fission as well as the known proportion of prompt and delayed neutrons produced when the μ-meson stops in ^{239}Pu are used to determine for the first time the absolute probability per a stopped muon of the prompt fission induced by atomic non-radiative transitions of μ meson: $W_{\mu\ fiss}$ = 0.21 ± 0.04, the absolute probability of the delayed fission per a stopped muon $W_{del.\ fiss}$ = 0.74 ± 0.18 and the limits of the probability of fission per a capture: 0.74 ± 0.18 ≤ $W_{\mu\ fiss}$ ≤ 0.94 ± 0.23. (auth)

22858 YIELDS AND KINETIC ENERGIES OF FRAGMENTS FROM FISSION OF THE ^{241}Pu NUCLEI INDUCED BY FAST NEUTRONS. Vorob'eva, V. G.; D'yachenko, N. P.; Kolosov, N. P.; Kuz'minov, B. D.; Sergachev, A. I.; Surin, V. M. Yadern. Fiz.; 19: No. 6, 1216-1221(Jun 1974). (In Russian).

The yields and kinetic energies of fragments from the ^{241}Pu fission by monoenergetic neutrons are measured in the neutron energy region from thermal to 5 MeV. The variations of the fragment mass and kinetic energy distributions are small for 5 MeV decrease of the excitation energy. The mean kinetic energy of fragments decreases by 1.2 MeV in the neutron energy range under consideration. The mean mass of the heavy fragment is practically constant. The energy dependence of the dispersion of the mass distribution of fragments is interpreted using the knowledge on the mass formation of fragments in the vicinity of the nuclear collapse. (auth)

22859 DELBRUECK AND NUCLEAR RAMAN SCATTERING OF 10.83-MeV PHOTONS BY DEFORMED AND SPHERICAL HEAVY NUCLEI. Jackson, H. E. (Argonne National Lab., IL); Thomas, G. E.; Wetzel, K. J. Phys. Rev., C; 9: No. 3, 1153-1167(Mar 1974).

A beam of monoenergetic γ rays, extracted from the CP-5 reactor, was used in a high-resolution measurement of the differential cross sections for photon scattering by Tb, Ta, Pb, Bi, Th, and ^{238}U. The spectrum of scattered photons was observed with a resolution of ~10 keV in a Ge(Li) detector whose sensitive volume was ~60 cm^3. For Pb and U extensive measurements of

the angular distributions for elastic and inelastic scattering were measured. For scattering angles $\theta < 45°$ the elastic scattering is dominated by the Delbrück effect. With the possible exception of Ta, for $\theta > 90°$ (where only nuclear resonance and Thomson scattering are important) both the magnitude and angular dependence of the elastic scattering cross section are in good agreement with the values which follow from the most recent photoabsorption cross sections in the corresponding targets. To an accuracy of ~10% the elastic and inelastic (nuclear Raman) scattering for U and Th can be deduced from the simple rotator model by using the parameters implied by the photoabsorption data. A trend of Raman scattering to be 10% weaker than expected is suggested by the data. For Ta and Tb the Raman scattering is substantially weaker than expected. (6 figures, 3 tables) (auth)

22860 EXPERIMENTAL STUDY OF THE DEFORMATION OF THE FISSION ISOMER IN ^{236}U. Heffner, R. H. Seattle; University of Washington (1973). 160p. University Microfilms Order No. 74-15,577.

Thesis (Ph. D.).

Internal conversion electrons were measured in delayed coincidence with fission fragments from the ^{236}U fission isomer. The decay curve deduced from the time spectrum of the isomer events shows a half-life of 144 ± 32 ns. The energy spectrum of these electrons shows structure consistent with E2 radiation from the $6^+ \rightarrow 4^+$ and $4^+ \rightarrow 2^+$ transitions from the ground-state rotational band built upon the 0^+ fission isomer. These gamma ray energies, E_γ, are expected to obey the leading order relation $E_\gamma = A(4J - 2)$ obtained from the adiabatic rotor model, where J is the spin of the emitting state. A tentative value of A = 3.54 ± 0.10 keV was deduced which should be compared to the corresponding parameter for the normally deformed ground state of 7.55 MeV. The deformation of the isomer was found to be more than twice that of the normally deformed ground state in ^{236}U. The intensity of the $6^+ \rightarrow 4^+$ transition (and of a possible $8^+ \rightarrow 6^+$ transition) was found to be low relative to the $4^+ \rightarrow 2^+$ transition when compared to a model calculation for the angular momentum feed to the rotational band. (RWR)

22861 DECAY OF ^{228}Ac. Dalmasso, J.; Maria, H.; Ythier, C. (Univ., Nice). Compt. Rend., Ser. B; 278: No. 3, 97-100(14 Jan 1974). (In French).

A β decay scheme for ^{228}Ac → ^{228}Th disintegrations based on γ spectra and coincidence measurements is presented. (FR)

22862 A COMPARISON OF DATA LIBRARIES FOR THERMAL FUEL CELL CALCULATIONS. Sahin, S. (Karadeniz Teknik Universitesi, Trabzon (Turkey)). Atomkernenergie; 23: No. 2, 151-152(1974).

2 figs.; 11 refs.

In numerical reactor analysis, there are two principal ways to enhance the accuracy of calculations: 1) The development of more accurate methods to solve the neutron transport equation, 2) the development of more accurate and consistent cross sections data libraries. It is obvious that the best mathematical method to solve the neutron transport equation cannot deliver reliable results if the cross sections are not reliable. In this work a comparison of the data set of Bondarenko (49 energy groups) and the XSDRN data library (123 energy groups) has been carried out for thermal thermionic fuel cell calculations. (auth)

22863 SEARCH FOR DELAYED NEUTRONS FOR SPONTANEOUS FISSION OF ^{252}Cf. D'yachenko, P. P.; Piksaikin, V. M.; Laital, A. Yadern. Fiz.; 19: No. 6, 1212-1215(Jun 1974). (In Russian).

The search for the so-called delayed neutrons from the spontaneous fission of ^{252}Cf is made using the method of measuring of the angular distribution of the neutrons emitted in fission. The obtained experimental data do not confirm the hypothesis that such neutrons exist. (auth)

22864 THERMAL-NEUTRON INDUCED TERNARY FISSION OF URANIUM-235. Pilione, L. J. University Park, PA; Pennsylvania State University (1973). 79p. University Microfilms Order No. 74-16,065.

Thesis (Ph. D.).

Thermal neutron induced ternary fission of uranium-235 has been studied with the use of a dielectric detector. The surfaces of dielectric detectors (cellulose nitrate) were exposed to ~4 MeV alpha particles. Chemical etching with a 10 M NaOH solution enlarged the alpha particle tracks to an average depth of 12 ± 3 μ and average diameter of 2.0 ± 0.5 μ. The microscopic holes were subsequently filled with a uranyl nitrate solution and exposed to a thermal neutron beam. A post neutron irradiation etch enlarged the fission tracks to a size easily discernible with an optical microscope. Thirty-three three-prong events were observed in 100,000 binary fission events. A detailed scattering analysis was carried out on each of the 33 events. Thirteen of these events did not satisfy the requirements for a binary fission fragment scattering with one of the constituent elements of the detector. These were treated as ternary fission events. The energy sensitivity of the cellulose nitrate foils allows observations of low energy ions, i.e., $E_{min} \gtrsim 2$ MeV for values of mass $\gtrsim 6$ amu. The masses and kinetic energies of the thirteen events were determined using an empirical range-energy formula and conservation of momentum and mass. The total ternary fission yield was found to be $10 \pm 2 \times 10^{-5}$ per binary fission for the third particle in the mass range $9 \lesssim A \lesssim 32$ amu and 1×10^{-5} binary fission for an event where all the masses were comparable. It was found that the heavy fragment gave up more nucleons in the formation of the third particle than did the light fragment. The kinetic energy of the third particle ranged in value from 3.7 MeV (9 amu) to 16.8 MeV (32 amu). Angular measurements indicate a correlation between the angle separating the third particle from the heavy fragment and the mass of the third particle. The results of this study suggest that the low energy emitted particles are formed under different conditions than those of higher energy which have been reported previously. (Diss. Abstr. Int., B)

22865 MEASUREMENT AND NORMALIZATION OF THE RELATIVE URANIUM-233 FISSION CROSS SECTION IN THE LOW RESONANCE REGION. Deruytter, A. J. (EURATOM, Geel, Belgium); Wagemans, C. Nucl. Sci. Eng.; 54: No. 4, 423-431(Aug 1974).

The ^{233}U fission cross section was measured as a well-collimated short flight path of the CBNM Linac from 50 eV to below thermal energy for a direct normalization to the 2200 m/s reference cross section. The fission reaction rate and the neutron spectrum were determined simultaneously with solid state detectors placed on each side of a back-to-back ^{233}U – ^{10}B layer. From the counting-rate ratios σ_f curves were calculated assuming a 1/v behavior of the ^{10}B(n,α)^{7}Li cross section. Several fission and resonance integrals were calculated from the normalized σ_f curve and compared with other published results. Moreover, the Westcott g_f factor was calculated from these data in order to check the shape of the fission cross section below 1 eV. Furthermore, a common normalization procedure based on the fission integral

$$\int_{0.1\ eV}^{17.4\ eV} \sigma_f(E)dE = (968.7 \pm 10.0)\ b \cdot eV$$

obtained from the measurements is proposed. (3 figures, 6 tables) (auth)

22866 DISTRIBUTION OF MASSES OF FRAGMENTS IN THE REGION OF THE SYMMETRIC PHOTOFISSION OF ^{235}U AND ^{237}Np. Kondrat'ko, M. Ya.; Korinets, V. N.; Petrzhak, K. A. Sov. At. Energy (Engl. Transl.); 35: No. 3, 866-868(Sep 1973).

Translated from At. Energ. (USSR); 35: No. 3, 214-215(Sep 1973).

In order to refine the shape of the mass-distribution curve, the yields of six products of the symmetric and almost symmetric fission of ^{235}U by bremsstrahlung photons with 14 MeV endpoint energy were measured. A radiochemical method was used to analyze the recoil fragments emitted from the thin target and absorbed in the collector layers. There is a clearly observed group of fragments of symmetric fission with a maximum for mass number 116. The kinetics involved in the fission of this nucleus and also ^{237}Np are discussed. By fitting the light-fragment yields with a Gaussian, evidence for symmetric photofission in both nuclei was educed. (RWR)

22867 YIELDS OF FRAGMENTS IN PHOTOFISSION OF ^{237}Np. Kondrat'ko, M. Ya.; Korinets, V. N.; Petrzhak, K. A.; Teodorovich, O. A. Sov. At. Energy (Engl. Transl.); 35: No. 3, 862-865(Sep 1973).

Translated from At. Energ. (USSR); 35: No. 3, 211-213(Sep 1973).

Fragment yields from fission of ^{237}Np by betatron bremsstrahlung for endpoint energies from 10 to 24 MeV were measured by a radiochemical method. NpO^2 was applied in a 200 $\mu g/cm^2$ layer on a metallic substrate. Corrections for self-absorption and absorption in the substrate were determined experimentally. Fragment yields were determined with respect to the ^{140}Ba yield as the ratio of the absolute saturation activities. The measured values for the yields for 24 mass numbers are tabulated. In addition, mass yield curves are shown for several energies. The yields of several specific products are discussed. (RWR)

Nuclear Theory

Refer also to abstracts 22174, 22309, 22403, 22406, 22409, 22748, and 22766.

22868 (BNL-18964) HEAVY-ION INDUCED TRANSFER REACTIONS: THEORY AND SOME DATA. Kahana, S. (Brookhaven National Lab., Upton, N. Y. (USA)). 1974. 17p. (CONF-740637-5). Dep. NTIS $4.00.

From international conference on reactions between complex nuclei; Nashville, Tennessee, USA (10 Jun 1974).

A rather general picture of direct reactions that has emerged recently is given. The remarks apply to elastic and inelastic scattering and transfer of a few nucleons. Diffractive behavior has appeared at quite low energies, where it was thought that the strong Coulomb field between massive projectile and reasonably heavy target would cast a classical hue over the transfer process. The key element in the low threshold for this behavior is an unexpectedly low absorption at grazing separations. A theoretical analysis of a reaction with nonvanishing angular momentum transfer is presented. It is necessary to consider nonvanishing (LM) if a complete understanding of the process is to be obtained. The magnetic (M) state population is emphasized. In his talk the author warned against believing optical potentials for small L elastic scattering. (7 figures) (RWR)

22869 (CERN-74-8) PROCEEDINGS OF TOPICAL MEETING ON INTERMEDIATE ENERGY PHYSICS, ZUOZ, SWITZERLAND, APRIL 4–13, 1973. (European Organization for Nuclear Research, Geneva (Switzerland); Schweizerisches Inst. fuer Nuklearforschung, Villigen). 10 Apr 1974. 228p. (CONF-730471-).

The conference included five papers. Separate abstracts were prepared for four papers. The other paper was outside the subject scope of NSA. (JFP)

For abstracts of individual papers see: 22174, 22395, 22603, and 22870.

22870 (CERN-74-8, pp 41-57) PRESENT AND FUTURE OF NUCLEAR STRUCTURE WITH HADRONIC PROBES. Tanner, N. W. (Oxford Univ.). 10 Apr 1974.

From intermediate energy physics meeting; Zuoz, Switzerland (13 Apr 1973).

A lecture is given on the scattering of medium-energy pions by nuclei in anticipation of an increase in intensity of about three orders of magnitude from the meson factories. (JFP)

22871 (COO-535-692) COMMENT ON MACROSCOPIC ANALYSIS OF (p,n) REACTIONS. Kunz, P. D.; Rickertsen, L. D.; Hoffmann, G. W. (Colorado Univ., Boulder (USA). Nuclear Physics Lab.; Texas Univ., Austin (USA). Center for Nuclear Studies). 1973. Contract AT(11-1)-535. 8p. Dep. NTIS $4.00.

The extraction of the isovector part of the optical potential from nucleon–nucleon optical potentials is discussed when the optical potentials are energy dependent. (2 figures, 1 table) (auth)

22872 (COO-3496-44, pp 34-43) LEVEL DENSITIES FOR SPHERICAL NUCLEI. Huizenga, J. R.; Behkami, A. N.; Sventek, J. S.; Atcher, R. W. 1974.

In studies of nuclear fission, low-energy nuclear reactions and transuranic nuclei.

22873 (COO-3496-44, pp 44-50) LEVEL DENSITIES FOR NUCLEI WITH STATIC DEFORMATION. Huizenga, J. R. Behkami, A. N.; Atcher, R. W.; Sventek, J. S.; Britt, H. C.; Freiesleben, H. 1974.

In studies of nuclear fission, low-energy nuclear reactions and transuranic nuclei.

22874 (COO-3496-44, pp 51-55) ANGULAR MOMENTUM DEPENDENT LEVEL DENSITY. Behkami, A. N.; Huizenga, J. R. (Pahlavi Univ., Shiraz, Iran). 1974.

In studies of nuclear fission, low-energy nuclear reactions and transuranic nuclei.

22875 (COO-3496-44, pp 119-127) INTERACTION POTENTIALS FOR HEAVY ION REACTIONS. Huizenga, J. R.; Freiesleben, H. 1974.

In studies of nuclear fission, low-energy nuclear reactions and transuranic nuclei.

22876 (DEMO-74/6) REFINED ISOMORPHIC MODEL OF THE CLOSED-SHELL NUCLEI: CLASSICAL PART. Anagnostatos, G. S. (Democritus Nuclear Research Center, Athens (Greece)). Apr 1974. 37p. Dep. NTIS (U. S. Sales Only) $5.00.

An extensive development of the classical part of the isomorphic model of the ground-state structure of the closed-shell nuclei ^{16}O, ^{40}Ca, ^{58}Ni, ^{90}Zr, ^{112}Sn, ^{142}Nd, and ^{208}Pb is presented. The model is basically a shell model whose main characteristic is the idea that a nuclear closed shell at the ground state has an average shape represented by a specific high-symmetry polyhedron of definite size. Specifically, the model briefly assumes stable dynamic equilibrium of nucleons on spherical shells with central symmetry. This leads to the conclusion that the different shells of a closed-shell nucleus have average shapes represented by specific concentric high-symmetry polyhedra derived from one another, whose vertices represent average nucleon positions. These polyhedra are the zerohedron, octahedron, hexahedron (cube), icosahedron, dodecahedron, icosidodecahedron, and rhombic triacontahedron, all of which may be used more than once but in different sizes. The sizes of all the polyhedra are calibrated to nuclear dimensions in a simple manner. In addition, a brief presentation of the application of the model to four nuclear properties is given, without the use of adjustable parameters: magic numbers do not necessarily correspond to nuclear closed shells, and vice versa; neutrons extend beyond protons, and predicted proton and neutron radii agree well with experimental data; the density of nuclear matter is verified as being approximately constant; the rotating and nonrotating parts of open-shell deformed rotating nuclei are specified, based on a closed-shell approximation. Even though the semiclassical and quantum mechanical parts of the isomorphic model are not given in this paper, the classical part alone demonstrates the workability of a model based exclusively on high spatial symmetry to investigate nuclear structure. A possible deeper physical meaning for the association of average closed shells with high symmetry polyhedra, however, remains to be investigated. (4 figures, 4 tables, 16 references) (auth)

22877 (IAE-2240) SUBSEQUENT DEVELOPMENT OF THEORY OF FINITE FERMI-SYSTEMS. Osadchiev, V. M.; Sapershtein, E. E.; Troitskii, M. A.; Khodel, V. A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1972. 40p. (In Russian). INIS.

Work done since 1967 is summarized, including further development of a method of A. B. Migdal for calculating nuclear properties, known as the "theory of finite Fermi systems." Work related to calculations on formulated schemes and their development is not included. The problem of spectra of low positions of peri-magic nuclei is considered; the solution requires introducing universal amplitudes of distribution of quasi particles at a definite angle. A method is given for calculating simultaneous remote particle-particle and particle–vacancy reactions in channels. An overall view of a universal amplitude and the symmetry ratio are presented. Static moments of activated even–even nuclei are discussed, and expressions are derived for static moments with consideration of pair correlations. Questions related to a weak interaction in a nucleus (double β decay and nonconservation of P evenness in nuclear forces). The change in the matrix density upon addition of a large number of particles to a Fermi system is considered. (tr-auth)

22878 (IAE-2286) THEORY OF MAGIC NUCLEI. Nosov, V. G.; Kamchatnov, A. M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1973. 26p. (In Russian). Dep. NTIS (US Sales Only) $4.50.

A consistent theory of the shell and magic oscillations of the masses of spherical nuclei is developed on the basis of the Fermi liquid concept of the energy spectrum of nuclear matter. A "magic" relationship between the system dimensions and the limiting momentum of the quasi-particle distribution is derived; an integer number of the de Broglie half-waves would fall on the nuclear diameter. An expression for the discontinuity in the nucleon binding energy in the vicinity of a magic nucleus is obtained. The role of the residual interaction is analyzed. It is shown that the width of the Fermi-surface diffuseness due to the residual interaction is proportional to the squared vector of the quasi-particle orbital angular momentum. The values of the corresponding proportionality factors (the coupling constant for quasi-particles) are determined from the experimental data for 52 magic nuclei. The rapid drop of the residual interaction with increasing nuclear size is demonstrated. (7 figures, 3 tables) (auth)

22879 (IFTJ-47/PS) ORBITAL AND COVALENCY EFFECT IN MAGNETIC NEUTRON SCATTERING. Kaprzyk, S. (Institute of Nuclear Physics and Techniques, Krakow (Poland)). Jan 1974. 16p. Dep. NTIS (US Sales Only) $4.00.

A general formula for the magnetic form factor in the presence of the covalency and orbital effect was derived. It was applied to two cases of A-type ions. (4 figures) (auth)

22880 (INIS-mf-1168/1, pp vp 15p) SHELL MODEL THEORY OF MAGNETIC MOMENTS. Lipas, P. O. (Helsinki Univ., Finland). 1973.

From Finnish summer school in nuclear physics, 1973; Liperi, Finland (11 Jun 1973).

The definition of the Schmidt lines are given and these are described for odd-proton and odd-neutron nuclei in diagrams. The features on the shell model with simple configuration mixing are explained and the estimates for heretofore unmeasured magnetic moments are calculated. (auth)

22881 (INIS-MF-1168-1) FINNISH SUMMER SCHOOL IN NUCLEAR PHYSICS, LIPERI, FINLAND, JUNE 11–16, 1973. [nd]. vp. INIS.

The conference included 11 papers. Separate abstracts were prepared for each paper. (JFP)

For abstracts of individual papers see: 22682, 22776, and 22882–22890.

22882 (INIS-MF-1168-1, pp vp, 15p) SHELL MODEL THEORY OF MAGNETIC MOMENTS. Lipas, P. O. (Univ. of Helsinki). 1973.

From Finnish summer school in nuclear physics; Liperi, Finland (11 June 1973).

The single-particle shell model corrected by first-order configuration mixing is used to discuss the magnetic moments observed in odd-A nuclei. The Schmidt lines, configuration mixing, and the use of parameter-free realistic interactions are discussed. (JFP)

22883 (INIS-MF-1168-1, pp vp, 23p) SPECTROSCOPY IN THE SECOND MINIMUM. Metag, V. 1973.

From Finnish summer school in nuclear physics; Liperi, Finland (11 June 1973).

A discussion is given of how one can in principle investigate the spectroscopic properties of states in the second minimum including even–even and odd-mass isomers. (JFP)

22884 (INIS-MF-1168-1, pp vp, 34p) ELEMENTARY APPLICATIONS OF THE SHELL MODEL. Green, A. M. 1973.

From Finnish summer school in nuclear physics; Liperi, Finland (11 June 1973).

22885 (INIS-MF-1168-1, pp vp, 43p) FISSION ISOMER LIFETIMES–THEIR SYSTEMATICS AND EXPERIMENTAL METHODS. Metag, V. 1973.

From Finnish summer school in nuclear physics; Liperi, Finland (11 June 1973).

A lecture is given on the general characteristics of fission isomers, experimental methods for measuring their half-lives, and the systematics of fission isomer half-lives. (JFP)

22886 (INIS-MF-1168-1, pp vp, 31p) FISSION ISOMERS. Pauli, H. C. 1973.

From Finnish summer school in nuclear physics; Liperi, Finland (11 June 1973).

The discussion of fission isomers covers the collective model, deformation energy, and the mass parameters. (JFP)

22887 (INIS-MF-1168-1, pp vp, 16p) MAGNETIC MOMENTS OF "SINGLE-PARTICLE" NUCLEAR STATES. Ogaza, S. 1973.

From Finnish summer school in nuclear physics; Liperi, Finland (11 June 1973).

The treatment of magnetic moments of single-particle nuclear states covers conjugate nuclei, the spin polarization effect, and anomalous g factors. (JFP)

22888 (INIS-MF-1168-1, pp vp, 17p) NUCLEAR GAMMA DECAY. Lawson, R. D. 1973.

From Finnish summer school in nuclear physics; Liperi, Finland (11 June 1973).

The treatment of nuclear gamma decay covers static moments, transitions in π_1 multiples, neutrons and protons in the same single-particle level, applications of the E2 transformation, particle–hole formation, and the proof that T/O ≥ full shell. (JFP)

22889 (INIS-MF-1168-1, pp vp, 29p) NUCLEAR ORIENTATION IN MOESSBAUER SPECTROSCOPY. Hirvonen, M. T.; Katila, T. E. (Helsinki Univ. of Tech.). 1973.

From Finnish summer school in nuclear physics; Liperi, Finland (11 June 1973).

The use of nuclear orientation in Moessbauer spectroscopy is discussed, and various Moessbauer measurements at very low temperatures are described in which nuclear orientation was actually observed and used are described. Boltzmann statistics and nuclear orientation, cold absorbers, and cold sources are discussed. (JFP)

22890 (INIS-MF-1168-1, pp vp, 29p) PARTICLE–VIBRATION COUPLING. Sips, L. 1973.

From Finnish summer school in nuclear physics; Liperi, Finland (11 June 1973).

The discussion of particle–vibration coupling in nuclei is restricted to the collective vibrational excitations associated with the changes in the shape (orbital degrees of freedom) and their influence on the particle motion. (JFP)

22891 (INIS-MF-1168-2) FINNISH SUMMER SCHOOL IN NUCLEAR PHYSICS, LIPERI, FINLAND, JUNE 11–16, 1973. [nd]. vp. INIS.

Separate abstracts are prepared for the 14 lectures included. (CES)

For abstracts of individual lectures see: 20582, 21486, 21892, 21931, 22325, 22397, 22578, 22579, 22614, 22777, 22841, 22842, 22892, and 23283.

22892 (INIS-MF-1168-2, pp vp, 25p) JASTROW METHOD AND ITS APPLICATION: A REVIEW. Ciofi degli Atti, C. 1973.

From Finnish summer school in nuclear physics; Liperi, Finland (11 Jun 1973).

The review lecture on the Jastrow method and its applications covers the basic formalism of the cluster expansion, choice of the variational functions, application to extended systems to few-body systems, and light nuclei, and phenomenological applications. (JFP)

22893 (IPNO-RC-73-4) FUSION REACTIONS BETWEEN COMPLEX NUCLEI. Barrier of Interaction. Limitation to Complete Fusion. Influence of Very Large Annular Momenta. Lefort, M.; Le Beyec, Y.; Peter, J. (Paris-11 Univ., 91–Orsay (France). Inst. de Physique Nucleaire). Mar 1973. 20p. INIS.

From 11th international winter meeting on nuclear physics; Villars, Switzerland (22 Jan 1973).

It is demonstrated that fairly accurate estimates can be made of the height of the interaction barrier by analyzing the Coulomb and nuclear potentials. The problem of complete fusion was examined systematically: total cross section of the reaction, fraction of the total cross section participating in the complete fusion, theoretical limit to complete fusion (Yrast levels, arbitrary shapes for the fusing system, rotating liquid drops), experimental measurements of the complete fusion cross section for the ($^{40}Ar + {}^{121}Sb$) system, further data on complete fusion induced by Ar, krypton induced reactions (complete fusion and fission of the compound system). In the conclusion, the importance of the entrance channel for the complete fusion between two complex nuclei is emphasized. (auth)

22894 (IPNO-T-74-04) CONTRIBUTION TO THE THEORETICAL STUDY OF NUCLEAR FORCES. Loiseau, B. (Paris-6 Univ., 75 (France)). Jan 1974. 174p. (In French). Dep. NTIS (U. S. Sales Only) $11.75.

Thesis.

The effects of the long-range three-body nuclear forces due to two-pion exchange are studied in the first part of this thesis. These forces are derived from dispersion relations in the static approximation. Their contributions, estimated by perturbation calculations, are found to be relatively important in triton, light hypernuclei and nuclear matter; therefore, it seems that the three-body forces cannot be ignored in nuclear structure problems. In the second part of this work the two-pion exchange contribution to the nucleon–nucleon force is calculated from pion–nucleon phase shifts and pion–pion interaction used as input into dispersion relations with the subtraction required by Regge asymptotic behavior. An equivalent potential is derived which, with the addition of the pion and ω exchange, reproduces many features of the long- and intermediate-range parts of the phenomenological potentials, without any adjustable parameter. Then a potential for nuclear structure calculation could be obtained by adding to it a phenomenological core. (FR)

22895 (ITF-74-30E) FOUR-PARTICLE MODEL OF NUCLEAR REACTIONS. Kuz'michev, V. E. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1974. 22p. Dep. NTIS (US Sales Only) $4.25.

The four-particle model of nuclear reactions is formulated. This allows one to consider the elastic scattering of compound subsystems and inelastic processes when one or two particles are transferred. The method of the Faddeev–Yakubovskii integral equations in the four-particle scattering theory with a pairing interaction is used as a basis. Integral equations are obtained for the components of the total wave function of the system. The relation of these components to the amplitudes of physical processes possible in the four-particle system is established. As an example, the case with separable pairing interactions is considered. (1 figure) (auth)

22896 (ITF-74-56P) E0-CONVERSION PROBABILITY DEPENDENCE UPON EQUIVALENT RADIUS OF THE NUCLEUS

R_0. Borisoglebskii, L. A. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1974. 8p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

It is shown that the probability of E0-conversion W(E0) and nuclear matrix elements of the electric monopole $M(E0) = \int \psi_g^* r^2 \psi_1 dr$ depends upon the equivalent radius of R_0. The expediency of using W(E0) of the reduced nuclear matrix element of the E0-field $\rho(E0)$ is proved. (auth)

22897 (JINR-P2-7989) AMPLITUDE STRUCTURE OF THE A(x → xN)B REACTIONS. Pak, A. S.; Poch, L.; Tarasov, A. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1974. 7p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

The structure of the amplitude of the A(x → xN)B reaction type is studied in the framework of the Watson theory with the interaction of particles in the initial and final states taken into account. The result obtained is used in explaining the equality of the cross sections for the reactions $\pi^{-12}C \to \pi^{-11}C$ and $\pi^{+12}C \to (\pi^+n + \pi^0p)^{11}C$ at T = 180 MeV. (auth)

22898 (JINR-P4-8013) MICROSCOPIC DESCRIPTION OF THE CHANGE IN COLLECTIVE PARAMETERS OF EVEN-EVEN NUCLEI BY ROTATING. Karadzhov, D.; Mikhailov, I. N.; Piperova, I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 35p. (In Russian). Dep. NTIS (US Sales Only) $4.75.

A microscopic cranking type model is suggested for a description of the states of the main rotational band of even-even deformed nuclei. Within this model the equations which determine the spin dependence of the quadrupole deformation and pairing parameters are formulated and numerically solved. Comparison of the theoretical estimates with the available experimental data shows the validity of the suggested scheme for description of nonadiabatic corrections to the matrix elements of the multiple operator at low spin values. (auth)

22899 (LBL-2908) ABRASION AND ABLATION OF HEAVY IONS. Bowman, J. D.; Swiatecki, W. J.; Tsang, C. F. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jul 1973. Contract W-7405-eng-48. 22p. Dep. NTIS $4.00.

The consequences of an "abrasion-ablation" theory of heavy-ion reactions are examined. The data used have been obtained from reactions of 2.1-GeV/nucleon ^{16}O with targets of H, C, S, Cu, and Pb. Cross sections were measured for the conversion of ^{16}O into various secondary beams corresponding to different amounts of proton loss and also for totally removing ^{16}O from the beam. "Abrading" refers to the "gouging out" or "shearing off" of a piece of the incoming ^{16}O by the target nucleus; "ablation," to the de-excitation of the resulting fragment. Calculations are done and compared with experiment. Although the calculated results are of the correct order of magnitude, it is felt that there is evidence for a very serious deficiency in the simple model. A more realistic picture would consider the recoiling target nucleons and pions left in the wake of the projectile. Possible ramifications of this type of "gangrenous bruise" picture are discussed. This report examines work in progress, and new developments may be expected continually. (9 figures) (RWR)

22900 (UCID-16516) MAGNETIC NUCLEAR FORCES, AN ISING NUCLEAR MODEL, AND ASYMMETRIC FISSION. MacGregor, M. H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 May 1974. Contract W-7405-eng-48. 13p. Dep. NTIS $4.00.

A study of hadron resonances has led to a geometry for nucleons and nuclei that is radically different from the geometry usually attributed to these particles. In this model the nucleons are cylindrical, and they bind together in a planar manner. Thus, collections of nucleons form two-dimensional nuclear layers, each being two fermis thick. These two-dimensional nuclear layers are directly analogous to the two-dimensional Ising layers that occur in magnetic materials. This report sketches the way in which the transition is made from hadron structure to nuclear structure. Nuclear forces and the alpha particle are discussed to illustrate the connection between hadron phenomenology and the phenomenology of nuclei. The nuclear Ising model is shown to account in a simple and natural manner for asymmetry in fission. (2 figures) (RWR)

22901 (UJV-3080-P) PROGRAM ABSTRACTS. Part 2. 701-1700. Schmid, J. (Ustav Jaderneho Vyzkumu, Rez (Czechoslovakia)). Jan 1974. 118p. (In Czech.). Dep. NTIS (US Sales Only) $9.00.

Abstracts of programs used in the calculation of problems in nuclear research are compiled. (JSR)

22902 CONSTRUCTION OF COLLECTIVE HAMILTONIAN IN THE MICROSCOPIC MODEL OF NUCLEUS. Dzholos, R. V.; Denau, F.; Yansen, D. (Joint Inst. for Nuclear Research, Dubna, USSR). Teor. Mat. Fiz.; 20: No. 1, 112-125(Jul 1974). (In Russian).

On the basis of the Hamiltonian of the microscopic model of nucleus with arbitrary residual interaction, the Hamiltonian is constructed which describes collective quadrupole excitations. The expression for potential energy of deformation is found and analyzed. The energies of lower collective states are calculated for the case when the potential energy possesses two minima. (auth)

22903 EFFECT OF π CONDENSATE ON THE PROPERTIES OF NUCLEI. Migdal, A. B.; Kirichenko, N. A.; Sorokin, G. A. (Inst. of Theoretical Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 19: No. 5, 185-187(5 Mar 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 19: No. 5, 326-328(5 Mar 1974).

It is shown that π condensation in heavy nuclei can lead to deformation of the nuclei and to the formation of shape isomers. The nucleon-density modulation due to the π condensate, and the associated effects in the case of scattering by nuclei, are considered. (auth)

22904 EXOTIC BOUND STATES OF STRANGE HADRONS. Backenstoss, G. (Karlsruhe Univ., Ger.); Zakrzewski, J. Contemp. Phys.; 15: No. 3, 197-225(May 1974).

A negatively charged strange hadron can be bound by the electromagnetic interaction in the Coulomb field of a nucleus to form an exotic atom. De-excitation of such an atom occurs with the emission of x-rays whose energies, line widths, and intensities have been measured. Deviations from the electromagnetic level scheme are observed for lower-lying states owing to the strong interaction of a hadron with a nucleus. When the wave function of a hadron begins to overlap with the nuclear density distribution, the hadron undergoes nuclear absorption via the strong interaction. The final outcome of such a process is the formation of a Λ hyperon which may be bound in a nucleus by the strong interaction. An exotic nucleus, or a hypernucleus, is thus formed making it possible to study the Λ-nucleon interaction. Excited states of hypernuclei decaying via weak, electromagnetic, or strong interaction have been observed and are extensively studied. Investigation of exotic atoms and hypernuclei provides basic information on the properties of strange hadrons, their interaction with nucleons, and the structure of the nuclear surface. (auth)

22905 CORRELATIONS IN A DOUBLY INCLUSIVE NUCLEAR REACTION. Gornov, M. G.; Ponosov, A. K.; Protasov, V. P.; Sergeev, F. M. (Moscow Engineering-Physics Inst.). JETP Lett. (USSR) (Engl. Transl.); 19: No. 5, 179-180(5 Mar 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 19: No. 5, 311-314(5 Mar 1974).

It is proposed to separate the mechanisms of multiple generation in elementary collisions by studying the correlations in the doubly inclusive nuclear reactions a + A → b + c + (anything). Using as an example the reaction $\pi^- + A \to \Lambda + K^0 +$ (anything), it is shown that the method is sensitive to the manner in which the secondary particles are produced. (auth)

22906 DIRECT REACTIONS, UNITARITY, AND HAUSER-FESHBACH THEORY. Weidenmueller, H. A. (Max-Planck Institut fuer Kernphysik, Heidelberg). Nukleonika; 19: No. 5, 387-399(1974).

A simple transformation bringing simultaneously the energy averaged $\langle S \rangle$ and $\langle S^+ \rangle$ matrices to diagonal form, thus reducing Hauser-Feshbach theory in the presence of direct reactions to the classical case without direct reaction contribution is described. The validity of the approximation consisting in the neglect of the level-level correlation in Hauser-Feshbach theory is discussed in terms of unitarity of the S-matrix and it is shown, that this can be consistently done only in the case of weak absorption in all channels. The case of strong absorption is also discussed. (auth)

22907 SIMPLE CONFIGURATIONS IN THE CONTINUUM. Weidenmueller, H. A. (Max-Planck Institut fuer Kernphysik, Heidelberg). Nukleonika; 19: No. 5, 401-410(1974).

The main concepts and formalism used in the description of intermediate structure phenomena are described. The problem of identification of some structure of the excitation curve as related to doorway state phenomena is discussed and some examples are briefly reviewed. (auth)

22908 EFFECTIVE MATRIX ELEMENTS IN DEFORMED NUCLEI. Piepenbring, R. (Inst. of Nuclear Science, Grenoble, France). Nukleonika; 19: No. 5, 455-480(1974).

Within the frames of the unified model the effective matrix element method of describing coherently different spectroscopic properties is formulated. The application to odd-mass deformed nuclei is discussed and the good agreement with experimental data is shown. Comparison with a method based on more complete model calculations is made. (auth)

22909 EFFECTIVE INTERACTIONS AND EFFECTIVE CHARGES IN THE SHELL MODEL. Brussaard, P. J. (State Univ., Utrecht). Nukleonika; 19: No. 5, 481-504(1974).

The realistic and effective nucleon-nucleon interaction was discussed. It is shown that the matrix elements of the effective interaction can be calculated using the Bethe–Goldstone equation. Effective proton and neutron charges were calculated for the E2 operator in the sd and fp shell in first-order perturbation theory, using the realistic Tabakin interaction. Second-order correction for the M1 operator and ft values were calculated for A = 39 and A = 41 nuclei. (auth)

22910 ANGULAR MOMENTUM 3n–j RECOUPLING COEFFICIENTS. Huang, C. S. Ann Arbor, MI; University of Michigan (1973). 141p. University Microfilms Order No. 74-15,757.

Thesis (Ph. D.).

Some properties of the recoupling coefficients of the 3n angular momenta are considered, especially generating functions, symmetries, and decompositions; the conclusions can be applied to the general case. Bargmann's functional space method is used to discuss the generating functions and symmetry properties of the 12-j coefficient and 15-j coefficient. A set of new notations together with an associated Moebius network representation for the angular momenta is designed to extend the above discussions to the general case of the 3n-j coefficient. The possibility of decompositions of 3n-j coefficient, $n \geq 3$, in terms of 3-j, 6-j, and 3(n-1)-j coefficients is investigated. Schwinger's operator method is used to check the generating functions of 12-j and 15-j coefficients obtained above. It is found that the Bargmann method can always be readily applied to construct the generating functions of all 3n-j coefficients; that the decompositions of the 3n-j coefficient in terms of 3-j coefficients, or 6-j coefficients, as well as a decomposition in terms of products of one 3(n-1)-j coefficient and two 6-j coefficients can be written down directly, with the aid of its Moebius network representation; that there exist 4n basic symmetries for the 3n-j coefficients, $n \geq 4$. A general procedure to construct, by combining the Schwinger method, the Bargmann method, and the Moebius network representation, the generating function of the 3n-j coefficient is also proposed. (Diss. Abstr. Int., B)

22911 SOLUTION OF THE FADDEEV INTEGRAL EQUATION WITHOUT CONTOUR ROTATION. Larson, N. M. (Oak Ridge National Lab., TN); Hetherington, J. H. Phys. Rev., C; 9: No. 2, 699-708(Feb 1974).

A new method of solution of the Faddeev equations for three-particle scattering above the breakup threshold using separable two-body potentials is present. No contour deformation is required with the method. The numerical techniques involved are explained in detail, and a justification for these techniques is given. A comparison is made to earlier calculations which used the contour-deformation technique. (auth)

22912 WHAT IS THE NUCLEAR OPTICAL POTENTIAL? Hodgson, P. E. (Oxford Univ.). Nature (London); 249: No. 5456, 412-414(31 May 1974).

A discussion is presented on the use and shortcomings of the concept of nuclear optical potentials. Matters discussed include the one-body potential, global potential, coupled-channel analyses, and polarization. It is shown that polarization and its dependence on nuclear asymmetry can easily be incorporated into the optical model, but other matters require sophisticated calculations before the effects due to the general optical potential and special processes can be disentangled. There is no effective general optical potential in which the effects of coupling to excited states, two-step reactions, core polarization exchange processes, etc., can be included by appropriate analytical terms in a general expression of the optical potential. Thus a concept of the optical potential arises in which it includes as many effects as possible in the treatment of parameters as functions of Z and A, but which must be used in a more sophisticated formation if certain effects are to be adequately treated. (UK)

22913 PHYSICS 1973. 37th Physicists Conference, Hamburg, Germany, September 24–28, 1973. Weinheim, Ger.; Physik Verlag GmnH (1973). 411p. (In German and English). (CONF-730993-).

The conference included 22 papers two of which were abstracted previously in NSA. For abstracts of these papers see abstract numbers 29: 27797 and 29: 08654. Separate abstracts are prepared for 7 papers; the remaining papers are not within the subject scope of NSA. (JFP)

For abstracts of individual papers see: 21252, 22335, 22347, 22497, 22720, 22794, and 22914.

22914 PROPERTIES OF FISSIONING NUCLEI. Specht, H. J. (Univ., Munich). pp 93-122 of Physik 1973. Weinheim, Ger.; Physik Verlag GmnH (1973). (In German).

From 37th physicists conference; Hamburg, F. R. Germany (24 Sep 1973). See CONF-730993-.

The properties of fissioning nuclei are discussed from two aspects. First the present knowledge on the double-humped fission barrier with all its experimentally observed consequences is reviewed. The possible relation between such pear-shaped nuclear deformations and the asymmetric fragment-mass distributions is discussed. (JSR)

22915 INTERACTION BETWEEN ATOMIC NUCLEI AND NUCLEONS AND PIJ. Oishi, K. (Gakushuin Univ., Tokyo). Uchusen Kenkyu; 17: No. 4, 562-566(Feb 1973). (In Japanese).

From symposium on charged particles and cosmic radiation; Hamamatsu, Japan (Dec 1971).

It is important to know the processes of collision of particles in space. The problem is to obtain the probability Pij of the collision in which the nucleus i collides with a high energy proton and transforms to the nucleus j. The analysis of data obtained by high energy nuclear reactions with accelerators is described. The problem is equivalent to obtain reaction cross section σ (A_T, Z_T, E_i, p, Ap, Zp) where A_T, Z_T, E_i, p, Ap, and Zp mean the mass number of target nucleus, the atomic number of target nucleus, incident energy, proton, the mass number of product nucleus, and the atomic number of product nucleus, respectively. Studies on the semi-empirical formulas of σ have been made by Rudstam. The distribution of σ in N–Z plane was obtained by assuming Gauss distribution. Three quantities namely the shift of position of the peak of distribution ($\Delta Z = Z_{OR} - Z_{O8}$), the width of distribution (R), and the value of σ corresponding to the peak (h) are required for determining the distribution of σ. The results of analysis show that correlation between ΔZ and $Ap/(A_T + 1)$, and correlation between R and $Ap/(A_T + 1)$ are seen moreover, strong dependence of h on $Ap/(A_T + 1)$ is also observed. The quantitative results of σ will be published in near future. (JA)

22916 GAPS IN THE ENERGY SPECTRUM OF A THREE PARTICLE REACTION. Haun, S.; Kamke, D. (Univ., Bochum, Ger.). Ann. Phys. (Leipzig); 29: No. 3, 263-270(Sep 1973).

Nuclear reactions with three particles in the exit channel are considered. When a sequential decay takes place, the energy spectrum (laboratory system) of a particle emitted in the second step of the decay may contain an interval that is kinematically forbidden. (auth)

22917 SEMIPHENOMENOLOGICAL MODEL OF THE NUCLEUS AND ITS APPLICATION TO DESCRIPTION OF THE ROTATIONAL SPECTRA. II. Krutov, V. A. (Leningrad State Univ.). Ann. Phys. (Leipzig); 29: No. 3, 217-232(Sep 1973).

Interaction between rotation and intrinsic motion is considered in the framework of the semiphenomenological model of the nucleus (the schemes of strong and weak coupling). The theory is applied to the description of the rotational spectra up to states with high values of the angular momentum. Very good agreement with experiment is obtained. (auth)

22918 SEMIPHENOMENOLOGICAL MODEL OF THE NUCLEUS AND ITS APPLICATION TO DESCRIPTION OF THE ROTATIONAL SPECTRA. I. Krutov, V. A. (Leningrad State Univ.). Ann. Phys. (Leipzig); 29: No. 3, 193-216(Sep 1973).

The general structure of the semiphenomenological model as a unified nuclear model describing the rotational, charge-oscillation, and configurational states is considered. The basic Hamiltonian of the model including the average field and short-range "residual" interactions is given. (1 figure) (auth)

22919 VARIATIONAL CALCULATION OF THE CRITICAL DISTANCE BETWEEN NUCLEI. Marinov, M. S.; Popov, V. S.; Stolin, V. L. (Inst. of Theoretical and Experimental Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 19: No. 1, 49-51(5 Jan 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 19: No. 1, 76-80(5 Jan 1974).

A variational calculation is performed of the critical distance R_c between colliding nuclei. In this calculation, the principal term of the quasimolecule (Z, Z, e) drops to the boundary of the lower continuum, and spontaneous production of positrons begins. (auth)

22920 SUM RULES AND THE NONEXCHANGE FORCE. Suzuki, T. (Inst. of Physical and Chemical Research, Wako, Japan); Hinohara, C. Phys. Rev., C; 9: No. 3, 1186-1187(Mar 1974).

The nonexchange residual interaction in the harmonic-oscillator shell model is obtained by using the sum rules generalized by Fallieros et al. [Phys. Rev. Lett.; 25: 827(1970); Phys. Rev., C; 7: 1709 (1973)]. (auth)

22921 QUADRUPOLE MOMENTUM OF THE 3 + STATES AND B (E2; 3' + → 3 +) AS CRITERIA OF APPLICABILITY OF PHENOMENOLOGICAL MODELS OF QUADRUPOLE EXCITATIONS OF EVEN NUCLEI. Grechukhin, D. P. (Inst. of Atomic Energy, Moscow). Yadern. Fiz.; 19: No. 6, 1226-1228(Jun 1974). (In Russian).

The static quadrupole momentum of any $|3+\rangle$ state is strictly zero and the reduced probabilities of E2 transitions between any $|3+\rangle$ states are also strictly zero in all phenomenological models of collective excitations of nuclei (PMCE) based on the assumption that the excitations of even nuclei can be described in terms of only collective degrees of freedom similar to the deformation parameters $\alpha_{2\mu}$ ($\mu = \pm 2, \pm 1, 0$) or to the equivalent to Bohr–Mottelson variables β, γ, θ_j ($j = 1, 2, 3$). These features of the PMCE excitation spectrum do not depend on the concrete Hamiltonian, therefore they can be used as a criterion of the accuracy of the main assumption made in all models similar to PMCE. Thus, observing the static quadrupole momentum of $|3+\rangle$ states and the probabilities B(E2; 3' + → 3 +) is a critical experiment of applicability of any PMCE to the studied nucleus, because zero values of the above-mentioned quantities are due to the main postulate used in all PMCE, i.e., the accurate extraction of collective quadrupole degrees of freedom from the total set of variables of the A-nucleon system. (auth)

22922 CALCULATION OF NUCLEAR REACTIONS USING PROJECTION OPERATOR TECHNIQUES. Tyan, Y. L. Austin, TX; University of Texas (1974). 88p. University Microfilms Order No. 74-14,778.

Thesis (Ph. D.)

A method is developed that allows the extension of shell-model calculations to continuum configurations. By using this technique, it is possible to do nuclear scattering and reaction calculations from a microscopic description. The spirit of the method may be summarized as follows: The single-particle potential occurring in the independent-particle Hamiltonian is deepened by an amount $\Delta(\Delta \sim 50$ to 200 MeV). The residual interaction, to which is added the repulsive single-particle potential $-\Delta$, is diagonalized with respect to the appropriate configurations based upon the bound eigenstates of the deepened single-particle potential. Both $-\Delta$ and the residual interaction contribute to configuration mixing. Next, the repulsive potential is diagonalized with respect to the continuum eigenstates of the deepened single-particle potential. Complete solutions are now obtained as the superposition of these eigenstates and those caused by the coupling of the continuum eigenstates to the bound eigenstates of the deepened single-particle potential. (Diss. Abstr. Int., B)

22923 SPIN–ORBIT COUPLING FORCE EFFECTS IN GIANT EXCITATIONS OF DOUBLY CLOSED SHELL NUCLEI. Ledoyen, F. (College Militaire Royal de Saint-Jean, Quebec). Can. J. Phys.; 52: No. 13, 1228-1232(1 Jun 1974).

We show that the spin–orbit coupling force may induce axial excitations higher in energy than the vector ones in muon capture without necessarily having $|M_A|^2/|M_V|^2 < 1$. (auth)

22924 PARAMETRIZATION OF THE ELASTIC SCATTERING AMPLITUDE OF THE α PARTICLES. Bulkin, V. S.; Tokarevskii, V. V. (Inst. of Nuclear Research, Kiev). Yadern. Fiz.; 19: No. 6, 1239-1244(Jun 1974). (In Russian).

The elastic scattering amplitude generated by the optical potential is studied. The effect of the optical potential parameters on the S matrix of the parametrized phase analysis (PPA) is investigated. The use of PPA to obtain the information on geometrical properties of nuclei is discussed. (auth)

22925 DISTRIBUTION OF EXCITED QUASIPARTICLES AND MEAN STATISTICAL CHARACTERISTICS OF NUCLEI. Ignatyuk, A. V.; Sokolov, Yu. V. Yadern. Fiz.; 19: No. 6, 1229-1238(Jun 1974). (In Russian).

The evaluation of statistical characteristics of an excited nucleus in terms of the thermodynamical functions of a system with fixed number of excited particles is considered. Such approach makes clear the origin of the phase transition in the thermodynamical description of the level density in the superfluid nuclear model, permits one to consider the nature of the even-odd differences in the density of levels, and explains the ladder-like form of the energy behavior of the parameter K_0^2 which determines the angular distributions of the fission fragments. (auth)

22926 SHIFT IN THE LARMOR NUCLEAR SPIN FREQUENCY PRODUCED BY A NONRESONANT RADIOFREQUENCY FIELD. Hiltbrand, E.; Borcard, B.; Sechehaye, R.; Piron, C.; Bene, G. J. (Univ., Geneva). Compt. Rend., Ser. B; 278: No. 7, 243-244 (11 Feb 1974). (In French).

The observed shift is quantitatively interpreted with high accuracy for radiofrequency field frequencies less than the Larmor precession frequency (even for relatively high amplitude values), only the component rotating in the same sense as the Larmor precession being considered. (tr-auth)

22927 EFFECT OF SHORT-RANGE CORRELATIONS ON COULOMB MATRIX ELEMENTS. Goldhammer, P. (Univ. of Kansas, Lawrence). Phys. Rev., C; 9: No. 3, 813(Mar 1974).

The normalization correction introduced by McCarthy and Walker is examined. It is concluded that it should be absent. (auth)

22928 ADVANCES IN NUCLEAR PHYSICS. Volume 7. Baranger, M.; Vogt, E. (Eds.). New York; Plenum Publishing Corp. (1973). 343p. $20.00.

Separate abstracts were prepared for each of the four chapters included. (JWR)

For abstracts of individual chapters see: 22929–22932.

22929 NUCLEON–NUCLEUS COLLISIONS AND INTERMEDIATE STRUCTURE. Mekjian, A. (Rutgers–The State Univ., New Brunswick, NJ). Advan. Nucl. Phys.; 7: 1-96(1973).

Intermediate resonance structure in the energy dependence of the nuclear cross section is examined. The optical model plus residual interactions is the basis for the description of resonance reactions. The doorway concept and its relation to the existence of intermediate structure are discussed. Some experimental data exhibiting intermediate structure are reviewed. (JWR)

22930 COULOMB MIXING EFFECTS IN NUCLEI: A SURVEY BASED ON SUM RULES. Lane, A. M. (Atomic Energy Research Establishment, Harwell, Eng.); Mekjian, A. Z. Advan. Nucl. Phys.; 7: 97-158(1973).

A systematic approach to Coulomb mixing based on two simplifications is set up: (1) the two-body Coulomb force is replaced by the effective one-body force which is essentially the charge monopole operator, (2) the mixing effects of this operator are evaluated in terms of two sum rules of this operator. These yield the mean-square amplitude and mean energy of the charge monopole mode of oscillation. Contributions of different admixed isospins can be separated. Evaluations are made with two models, the shell model and an improved model taking two-body correlations into account. For the latter, it is very useful to proceed by analogy with the well-known charge dipole problem. Experiment and theory for the different observed aspects of Coulomb mixing are compared. An analysis is also made of the most complete calculation available of an analog state. Generally experiment and theory are in accord, especially when the correlated model is used. When sum-rule evaluations are made with the shell model, no explanation is found of the Nolen–Schiffer anomaly; rather the opposite, viz., a large second-order shift (–2 MeV for ^{208}Pb) is found which reduces the estimated Coulomb displacement. However, when correlation effects are included, not only is this second-order shift less, but one finds evidence that correlations may increase the first-order term. These two effects are in the right direction but probably insufficient in magnitude to explain the anomaly. (auth)

22931 BETA STRENGTH FUNCTION. Hansen, P. G. (European Organization for Nuclear Research, Geneva). Advan. Nucl. Phys.; 7: 159-227(1973).

Information about nuclear structure that may be gained from the study of beta-decay properties of nuclei far away from beta stability is discussed. The treatment of beta decay rates in terms of strength functions is examined in detail. Knowledge acquired through the study of beta-decay strength functions is summarized and prospects for future research are suggested. (JWR)

22932 GAMMA-RAY STRENGTH FUNCTIONS. Bartholomew, G. A.; Earle, E. D.; Ferguson, A. J.; Knowles, J. W.; Lone, M. A. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Advan. Nucl. Phys.; 7: 229-324(1973).

Gamma-ray strength functions in $A \geq 90$ nuclei are examined in detail. The theoretical basis is reviewed and experimental methods are surveyed. Properties of γ-ray strength functions are discussed and some promising uses of strength function information are described. (JWR)

22933 POSSIBILITY OF DYNAMIC DEFORMATION OF SPHERICAL NUCLEI. Zelevinskii, V. G. (Inst. of Nuclear

Physics, Moscow). JETP Lett. (USSR) (Engl. Trans.); 19: No. 3, 112-114(5 Feb 1974).

Translated from Zh. Eksp. Teor. Fiz.; Pis'ma Red.; 19: No. 3, 179-181(5 Feb 1974).

It is demonstrated with a simple model that, as the angular momentum of the nucleus is increased, a dynamic instability of the spherical state can set in, which is due to the competition between the pairing and the forces of quadrupole deformation. (auth)

22934 IMPORTANCE OF EXACT ANTISYMMETRIZATION IN CORE-POLARIZATION EFFECT OF NUCLEI. Ando, K. (Kyoto Univ.); Bando, H. Progr. Theor. Phys. (Kyoto); 51: No. 3, 954-955(Mar 1974).

Effective interactions through core polarization have been shown to undergo drastic changes by taking particular higher-order terms as a vertex modification. It is shown here that results are stabilized if exact antisymmetrization between valence and core-excited nucleons is carried out. Multiple scattering equations for the (2p−1h) system are constructed which contain all-order interactions between three pairs antisymmetrized in every step. The following conclusions are reached: exchange effects between valence and core-excited nucleons are very important when collectivity of the core phonon is increased; it is dangerous to treat them partially, and exact antisymmetrization is indispensable. Results are stabilized in the exact treatment of antisymmetrization, even around the collapse point of the core phonon. The p−p interactions seem to increase the enhancement factors. (2 figures) (RWR)

22935 COHERENT AND INCOHERENT MULTIPLE PRODUCTION IN NUCLEI. Gottfried, K. (CERN, Geneva). pp 79-95 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973). See CONF-730642-.

Current interpretations of incoherent and coherent multiparticle production from nuclear targets at high energies are reviewed. Particular emphasis is placed on the multiplicity and inclusive distributions observed at NAL and cosmic ray energies. It is demonstrated that the nuclear process is exceeding sensitive to the very early stages of the underlying two-body collision, and that it therefore yields valuable information that cannot be obtained in collision with hydrogen. The astonishingly low multiplicities observed in complex nuclei are shown to be inconsistent with most models of the production process. A new model of the collision is proposed in which the local energy flux plays the dominant role. It provides a successful and parameter-free account of the data. (auth)

22936 EXPERIMENTAL SITUATION IN COHERENT PRODUCTION. Bingham, H. H. (Univ. of California, Berkeley). pp 96-108 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973). See CONF-730642-.

Some recent experimental results on coherent production reactions from nuclear targets are reviewed and discussed: the A_2 and L controversy, A_1 branching ratio and O^- absorption, $Q \to K\omega$, $\pi \to 5\pi$, doubly diffractive processes, $K \to K^*$ (890), $\pi \to \rho(?)$, $\pi \to 4\pi(?)$, $\Delta I \neq 0$ processes. (auth)

22937 COHERENT PARTICLE PRODUCTION AND THE PROPAGATION OF HADRONIC SYSTEMS THROUGH NUCLEAR MATTER. Van Hove, L. (CERN, Geneva). pp 109-113 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973). See CONF-730642-.

Recent experiments on coherent diffraction dissociation of high energy hadrons on nuclei lead to study the propagation of excited hadronic systems through nuclear matter. The theoretical treatment of this problem must take into account the evolution of the internal state of the hadronic system as it collides with successive nucleons. The main elements of such a treatment are introduced, and the time-dependent approach to the multiple scattering theory of Glauber is generalized. (auth)

22938 COULOMB PRODUCTION. Stodolsky, L. (Max-Planck-Institut fuer Physik und Astrophysik, Munich). pp 114-117 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973). See CONF-730642-.

Production induced in the Coulomb field by high energy particles is briefly reviewed. An extension of the method that can be used to find total cross sections of elementary particles with the photon is stressed. (auth)

22939 NON-DIFFRACTIVE NUCLEAR PRODUCTION PROCESSES. Faeldt, G. (Univ. of Lund, Sweden). pp 123-126 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973). See CONF-730642-.

The theory for a class of nuclear production processes where the underlying nucleon amplitudes vanish in the forward direction is reviewed. Both Coulomb and strong production processes are considered. (auth)

22940 NAIVE VIEW OF HIGH ENERGY HADRON−NUCLEUS COLLISIONS. Goldhaber, A. S. (Los Alamos Scientific Lab., NM). pp 133-135 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973). See CONF-730642-.

High energy (1,000 GeV) nucleon−nucleus collisions in emulsion give an indication of the nature of multiple interactions of very fast "excited hadrons." The data suggest that a cascade model of successive hadron production is not as close to the truth as a two-fireball model, in which at least the fast fireball does not disintegrate before leaving the nucleus, unless it is multiply excited by several successive collisions. (auth)

22941 MEDIUM ENERGY PION−NUCLEUS SCATTERING. Wilkin, C. (CERN, Geneva). pp 157-167 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973). See CONF-730642-.

The wealth of experimental information on pion-nucleus scattering presented at the 1971 Dubna conference has led to intensive theoretical work. This review is therefore biased towards the interpretation of data, rather than the presentation of new data. The work is mainly confined to the study of elastic and total cross-sections. (auth)

22942 FRESNEL APPROXIMATION TO HIGH-ENERGY NUCLEAR SCATTERING. Frahn, W. E.; Schuermann, B. (Univ. of Cape Town). pp 184-187 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973). See CONF-730642-.

Starting from Glauber's eikonal approximation, we have developed systematic approximation procedures for high-energy nuclear scattering which are based on two different expansions of the free-space propagator: the "eikonal expansion" and the "Fresnel expansion." We study, in particular, the first order of the latter expansion, the Fresnel approximation, for both potential scattering and multiple scattering in complex nuclei. By employing the unitary transformation that connects the Fresnel and eikonal propagators, we derive closed expressions for the potential and multiple scattering amplitudes which are formally similar to the corresponding expressions in Glauber theory. We show that Fresnel diffraction in high-energy nuclear scattering manifests itself in a characteristic Dyson-type ordering of the effective interaction operators with respect to their z-coordinates. (auth)

22943 KINEMATICS AND OFF-ENERGY-SHELL EFFECTS IN MULTIPLE SCATTERING. Kujawski, E. (Massachusetts Inst. of Tech., Cambridge); Lambert, E. pp 188-190 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973). See CONF-730642-.

A report is presented on work dealing with the question on what information about the nucleus or elementary interaction may be obtained from intermediate-energy elastic nuclear scattering: namely, the possibility of investigating two-body nuclear correlations and the off-energy-shell behavior of the projectile-nucleon interaction. (auth)

22944 SCATTERING OF HIGH ENERGY PARTICLES BY NUCLEI. Feshbach, H. (Massachusetts Inst. of Tech., Cambridge).

pp 191-194 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973). See CONF-730642-.

The multiple scattering theory of Kerman, McManus and Thaler is extended to include triple scattering effects. The triple scattering term in the optical potential is approximately proportional to the triple correlation function. The methods of Feshbach, Gal and Hüfner are generalized to provide a coupled channel description of the elastic scattering of fast particles including triple scattering. The coupling potentials depend directly on the pair and triple correlation functions. Numerical calculations are performed for protons at 1.69 GeV/c momentum on ^{4}He. Center-of-mass correlations and phenomenological short-range dynamical correlations are tested using a spin–isospin averaged nucleon–nucleon amplitude. The differential cross section around the second diffraction minimum and third diffraction peak is particularly sensitive to triple scattering effects while only minor effects at the second diffraction peak are obtained. (auth)

22945 THEORY OF THE PION–NUCLEUS OPTICAL POTENTIAL. Cammarata, J. B.; Banerjee, M. K. (Univ. of Maryland, College Park). pp 195-197 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973). See CONF-730642-.

The role of pion-nucleus crossing the construction of an optical potential is discussed, and it is shown that crossing has a significant effect on the cross sections and the elastic scattering wave functions of low energy pions. (auth)

22946 APPROACH TO PION–NUCLEUS SCATTERING NEAR THE (3,3) RESONANCE. Barshay, S. (Univ. of Copenhagen); Rostokin, V.; Vagradov, G.; Brown, G. E. pp 198-199 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973). See CONF-730642-.

A new approach to pion-nucleus scattering near the first pion-nucleon resonance is developed which is based upon the modification of the pion Green function due to isobar-hole excitation in the nuclear medium. A zero in the inverse propagator at zero frequency signals a π^0 condensate and it is noted that this possibility exists in neutron stars due to the attraction that may be provided by isobar-hole excitation when the nucleon density exceeds ~0.6 $(fm)^{-3}$. (auth)

22947 PION PRODUCTION FROM NUCLEI. Sternheim, M. M. (Univ. of Massachusetts, Amherst); Silbar, R. R. pp 282-284 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973). See CONF-730642-.

A semiclassical model was used to calculate $\pi^\pm$ production by protons from nuclei. The overall agreement with data at 740 MeV is quite good. Ambiguities arising from the nuclear corrections are found to be larger than the effects of moderate variations of the nuclear surface parameters. (auth)

22948 GAMMA-RAYS AND FRAGMENTS FROM MESON INTERACTIONS WITH NUCLEI. Plendl, H. S. (Florida State Univ., Tallahassee). pp 289-298 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973). See CONF-730642-.

In recent work on prompt γ-ray spectra following nuclear interactions of stopped and fast mesons, many reaction channels have been observed simultaneously. Reactions resulting in removal of one or several α-particles (or of equivalent nucleons) from the target nucleus were found to have high yields relative to absorption resulting in emission of two nucleons and to fast-meson induced knock-out of a single nucleon. Related work on nucleon and fragment spectra from π^- absorption indicates that four correlated nucleons (two neutrons and two protons) are involved in a relatively large fraction of π^- absorption processes. Common and distinguishing features of these experiments are reviewed, and the results are discussed in terms of possible reaction mechanisms. (auth)

22949 TOTAL MUON CAPTURE RATES, AVERAGE NEUTRINO ENERGY, AND NUCLEAR STRUCTURE. Bernabeu, J. (CERN, Geneva). pp 303-307 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973). See CONF-730642-.

A method of avoiding the uncertainty associated with the mean neutrino energy in the Primakoff closure approximation to muon capture rates is discussed. Energy weighted sum rules are used for the corrective terms which are involved. A near model independent discussion is then possible, and the total rates are shown to be a very sensitive tool for studying the nuclear structure of the target. The explicit form of the sum rule is given in terms of effective interaction matrix elements. A possible generalization to $T \neq 0$ nuclei is finally given. (auth)

22950 NUCLEAR MATTER AND CHARGE DISTRIBUTIONS. Jackson, D. F. (Univ. of Surrey, Guildford, Eng.). pp 323-333 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973). See CONF-730642-.

The theoretical and experimental methods currently available for the study of nuclear charge and matter distributions are listed and compared. The recent model-independent analyses of elastic electron scattering and muonic x-ray data are reviewed, followed by a review of the microscopic description of medium and high energy scattering of strongly-interacting projectiles from nuclei in terms of an optical potential derived from the nuclear matter distribution and a two-body interaction. An indication is given of which properties can be determined by the various measurements. (auth)

22951 NUCLEON DISTRIBUTION DEPENDENCE OF PROTON–NUCLEUS SCATTERING. Lombard, R. J. (Institut de Physique Nucleaire, Orsay, France); Auger, J. P. pp 334-335 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973). See CONF-730642-.

Several kinds of nuclear densities, corresponding to different approaches to the nuclear many-body problem, are used to calculate elastic and inelastic proton–nucleus differential cross sections. (auth)

22952 HIGH MOMENTUM ANALYSIS OF THE STRUCTURE OF NUCLEI. Gillet, V. (CEN, Saclay, France). pp 340-355 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973). See CONF-730642-.

After a discussion of the momentum content of nuclear wave functions, a review is given of theoretical and experimental results of high energy inelastic coherent scattering of electrons and hadrons with respect to the information they may bring on the distribution of high momenta in nuclei, on nuclear structure, on intrinsic deformed states and on nuclear clustering. (auth)

22953 QUASI-FREE SCATTERING AND NUCLEAR STRUCTURE. Maris, T. A. J. (Universidade Federal do Sul, Porto Alegre, Brazil). pp 356-368 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973). See CONF-730642-.

Quasi-free proton–proton and electron–proton scattering is reviewed. Some recent developments and open problems are also discussed and a new type of quasi-free (p,2p) measurement is described. (auth)

22954 MICROSCOPIC DESCRIPTION OF THE SPREADING AND DECAY OF HOLE STATES. Fritsch, W.; Lipperheide, R.; Wille, U. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). pp 391-395 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973). See CONF-730642-.

The structure of nuclear hole states is discussed within the spectral function concept. The quasi-particle approximation and

fully microscopic treatments of the hole spectral function are reviewed. Results of recent microscopic finite-nucleus calculations are presented. (auth)

22955 QUASIFREE SCATTERING ON CLUSTERING PARTICLES AND Q-VALUES. Cueer, P. (Centre de Recherches Nucleaires, Strasbourg); Sakamoto, Y. pp 396-399 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973). See CONF-730642-.

When the c.m. wave function of a cluster particle has its oscillatory structure in the interior region, the asymptotic form of the wave function, which essentially depends on the binding energy of the cluster particles in the nucleus, accounts for the large parts of the cross section. (auth)

22956 NUCLEAR PHYSICS, NEUTRON STARS, AND THE PROPERTIES OF MATTER AT HIGH DENSITIES. Baym, G. (Univ. of Illinois, Urbana). pp 436-444 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973). See CONF-730642-.

The theory of the properties of matter at high densities is reviewed, including recent developments in the questions of the structure of nuclei in neutron star matter; possible solidification of neutron matter under high pressure; condensation of pions into a single microscopic mode, a possible new state of superfluidity of matter; and hyperonic matter. The relation to the structure of neutron stars is discussed. Attempts to determine the equation of state at ultrahigh densities, and their astrophysical applications are considered. (auth)

22957 NEUTRON DISTRIBUTIONS. Barrett, R. C. (Univ. of Surrey, Guildford, Eng.). J. Phys. (Paris), Colloq.; No. 4, 23-28(1973).

From Centenary congress on the French Physical Society; Vittel, France (28 May 1973).

Calculations of neutron density distributions from single-particle, Hartree–Fock and Thomas–Fermi models are reviewed. A survey is made of experiments whose results depend on the neutron distribution or the neutron–proton density difference and the predictions of model densities are compared with the experimental results. (FR)

22958 VALUE OF ELECTRONIC HYPERFINE ANOMALIES TO NUCLEAR AND SOLID STATE PHYSICS. Stone, N. J. (Oxford Univ.). J. Phys. (Paris), Colloq.; No. 4, 69-75(1973).

From Centenary congress on the French Physical Society; Vittel, France (28 May 1973).

The hyperfine anomaly has been primarily considered as a parameter of interest in connection with nuclear dipole moment theory. It is shown that the present state of the theory of the effect limits this application. In contrast the comparison of anomaly measurements in different electronic environments yields information concerning the origin of the magnetic hyperfine interactions without requiring a precise quantitative calculation of the anomaly a priori. Recent anomaly results on dilute Ir and Au isotopes in ferromagnetic alloys, which indicate local moment formation at the Ir and Au site, are discussed. (FR)

22959 THEORY OF THE NUCLEAR MAGNETIC MOMENT. Chemtob, M. (CEN de Saclay, Gif-sur-Yvette, France). J. Phys. (Paris), Colloq.; No. 4, 77-86(1973). (In French).

From Centenary congress on the French Physical Society; Vittel, France (28 May 1973).

The nuclear magnetic moment is examined from the point of view of the information it gives on the nuclear electromagnetic interaction and the virtual mesic effects. The results of the phenomenological theory are reviewed. This discussion is supplemented by an outline of the noncovariant formalism of exchange currents. The theoretical predictions are first examined for magnetic moments of odd nuclei near closed shells. The consideration of mechanisms of exchange currents and core polorization by the residual interaction are sufficient to give a qualitatively satisfactory picture. The situation is then examined for 2- and 3-nucleon systems by considering the extension to other known static properties of these systems (quadrupole moment and radiative capture of slow neutrons). The role of 2π exchange and of nonstatic effects is studied. (FR)

PHYSICS (RADIATION AND SHIELDING)

Radiation Physics

Refer also to abstracts 21204, 21365–21367, 21375, 21845, 22553, 22997, and 23494.

22960 (CONF-740707-1) ELECTRON ATTENUATION LENGTHS IN CARBON FILMS. Arakawa, E. T.; Braundmeier, A. J.; Williams, M. W.; Hamm, R. N.; Birkhoff, R. D. (Oak Ridge National Lab., Tenn. (USA)). 1973. 4p. Dep. NTIS $4.00.

From annual conference on nuclear and space radiation effects; Fort Collins, Colorado, USA (15 Jul 1974).

A method has been developed for obtaining electron attenuation lengths in solids from measurements of photoelectric yield as a function of photon angle of incidence. (MHR)

22961 (IKF-32, pp 71-73) MULTIPLE SCATTERING OF LIGHT AND HEAVY IONS IN SOLID TARGETS. Groeneveld, K. O.; Spahn, G.; Meckbach, W. 1973. (In German).

22962 (JAERI-M-5486) APPLICATION OF ORTHOGRAPHY TO THE ANGLE FACTOR CALCULATION IN RADIATION PROBLEMS: THE SHADOW AREA METHOD. Abe, K. (Japan Atomic Energy Research Inst., Tokyo). Dec 1973. 41p. (In Japanese). INIS.

A new method to calculate an angle factor in the radiation problem (named the "shadow area method") is described. In this method the idea of orthography is applied to angle factor calculation, and the angle factor is given as a function of the shadow areas of the radiating and the irradiated bodies by parallel beams. By the shadow area method, the angle factor, written in fourfold integration in the Lambert's equation, can be expressed in double or single integration for the three or two dimensional problem respectively, and besides the integrated function becomes simple in most cases. Angle factors may thus be obtained analytically in many problems, and where not obtained analytically, accuracy and rapidity of the numerical integrations can be increased considerably. (auth)

22963 (JAERI-M-5558) COMPUTER PROGRAM TYIELD FOR CALCULATION OF THICK-TARGET YIELDS AND CHARGED-PARTICLE RANGES. Hata, K.; Baba, H.; Baba, S. (Japan Atomic Energy Research Inst., Tokyo). Feb 1974. 128p. (In Japanese). NTIS (US Sales Only).

The program TYIELD has been developed for calculation of the ranges of charged particles and nuclear reaction yields for the infinitely thick targets. Thirty values of the thick target yield are given for the irradiation intervals of $1/_{100}$ to 10 times the half-life, and also for one-hour irradiation and the saturation factor. In addition, thick-target yields can be obtained for the optional intervals. For calculation of a thick target yield, the excitation function must be available. The projectiles used are charged particles of atomic number less than 11, and the energy range is from 2 MeV to 500 GeV in proton equivalent. These limitations are imposed by range calculation. The target form can be of an element, compound, or mixture. The program size is of 62 K words and computation required for one nuclear reaction is less than 2 min in the CPU time. In the Appendix are given the FORTRAN list, proton ranges calculated for all the elements, thick-target yields for 218 charged-particle induced reactions useful for radioisotope production, and a compilation of excitation functions. (auth)

22964 (KFKI-74-15) CALCULATION OF SPATIAL DISTRIBUTION OF IRRADIATING FLUX FROM CIRCULAR AND CYLINDRICAL SOURCES. Vass, S. (Kozponti Fizikai Kutato Intezet, Budapest (Hungary)). 1974. 12p. Dep. NTIS (US Sales Only) $4.00.

Formulas are given for the calculation of spatial flux distributions of irradiation emitted from any circular or cylindrical source, and for the calculation of the components and absolute value of the flux gradient vector. Computed results are illustrated by drawings. (auth)

22965 (ORO-2911-16) INTERACTION OF HEAVY IONS WITH MATTER. Annual Report. Boring, J. W.; Johnson, R. E. (Virginia Univ., Charlottesville (USA). Research Labs. for the Engineering Sciences). Jun 1974. Contract AT(40-1)-2911. 45p. (ESS-3930-111-74). Dep. NTIS $5.25.

The application of collision cross sections to radiation damage calculations by slow heavy particles (secondaries) in enzymes is discussed. In these calculations, an attempt is made to find appropriate models for describing experimental results for heavy particle damage to biologically active systems. A major problem here is modeling the slowing of the particle as well as the inactivation cross section and secondary processes. Several models are discussed for describing inelastic energy loss and stopping in materials. (MHR)

22966 (PRNC-173) TECHNIQUE FOR MEASURING GAS STOPPING POWER FOR ALPHA PARTICLES USING TWO SOLID STATE DETECTORS. Michelen Embarek, J. E. (Puerto Rico Nuclear Center, Mayaguez). Mar 1974. 71p. Dep. NTIS (US Sales Only) $6.75.

Thesis.

The stopping power for alpha particles over a range of 1 to 5 MeV have been measured in the following gases: air, O_2, N_2, CO_2, N_2O, CF_4, CCl_2F_2, and some hydrocarbon compounds like C_3H_8, C_3H_8, C_2H_6, C_2H_4, and CH_4, using an ^{241}Am alpha source fastened to a screw in line with two solid state detectors connected in parallel. From these measurements atomic stopping cross sections of alpha particles in tissue (H, 10.1%; C, 12.1%; N, 4.0%; 0, 73.6% by weight) have been evaluated. These results are in good agreement with those values given in the literature. (auth)

22967 (SZS-154) GAMMA RADIATION FIELDS OF EVENLY DISTRIBUTED FISSION PRODUCT MIXTURES. Schuricht, V.; Zappe, D.; Eiteljoerge, N.; Noack, W. (Staatliche Zentrale fuer Strahlenschutz, Berlin (German Democratic Republic)). Jan 1974. 32p. (In German). Dep. NTIS (US Sales Only) $4.75.

The knowledge of the radiation field of evenly distributed gamma emitters, especially that of fission products on the ground, is essential for assessing exposure in the radiation field, calculating necessary shielding and investigating the response of radiation detectors. Therefore many authors dealt with experimental and theoretical studies of such radiation fields for certain cases. An evaluation of publications on this topic is given. Starting from the gamma spectra of fission product mixtures and the methods for calculating the radiation field of gamma emitters the methods for determining the energy and angular distribution of the quantum flux density of fission product mixtures and the results obtained are discussed. (auth)

22968 (USC-113P-51) INVARIANT IMBEDDING AND RADIATION DOSIMETRY. IX. Inverse Problem of Determining a Plane Source in a Finite Isotropically Scattering Target Slab. Technical Report No. RB73-17. Bellman, R.; Fymat, A. L.; Ueno, S.; Vasudevan, R. (University of Southern California, Los Angeles (USA)). May 1973. Contract AT(04-3)-113. 17p. Dep. NTIS $4.00.

Considering a homogeneous, isotropically scattering target slab of optical thickness x, containing an internal plane emitting source, the aim of the present paper is to determine the distribution of the internal emitting source by measuring the angular distribution of the intensity of radiation emergent from the slab. First, a system of differential recurrence relations for the intensity of finite order scattered radiation emergent from the top is deduced. In other words, a Cauchy system for determining the finite order emergent intensity is expressed in terms of a source function in the diffuse radiation field and the Fredholm resolvent that were computed in a preceding paper (cf. Bellman, Ueno and Vasudevan). Then, a quasilinearization technique is used to solve the inverse problem of determining an internal emitting source characteristics by measuring the radiation field emergent from the top. This method will be employed in future computations relating to realistic situations in the radiation diagnosis and therapy. (auth)

22969 REGULATIONS FOR THE ADMINISTRATION AND ENFORCEMENT OF THE RADIATION CONTROL FOR HEALTH AND SAFETY ACT OF 1968. Publication No. (FDA)73-8015. Washington, DC; Food and Drug Administration (1972). 40p.

The regulations were established to protect the public from unnecessary exposure to radiation from electronic products. This is any ionizing or nonionizing electromagnetic or particulate radiation or any sonic, infrasonic, or ultrasonic wave which is emitted from an electronic product as the result of the operation of an electronic circuit in such a product. The performance standards required, regulations regarding the standards, procedure for notification of defects, and a list of the required records which must be kept are described. (Pollut. Abstr.)

22970 STUDY OF THE PRINCIPAL PARAMETERS DETERMINING WHETHER RADIOISOTOPES OR X-RAYS SHOULD BE USED IN INDUSTRIAL RADIOGRAPHY. Bull. Inform. A. T. E. N. (Ass. Tech. Energ. Nucl.), Suppl.; No. 105, 7-14(Jan 1974). (In French).

The effects of the following parameters were considered: irradiation room, workshops, work yards, and the nature of the objects radiographed (materials, form, thickness); legislation (acquisition and retaining of radiation emitters, radioprotection regulations for x-ray and γ-radiography installations); economic aspects (investments, annual expenses, putting into operation costs, insurances). (FR)

22971 THREE-DIMENSIONAL DOSIMETRIC PHANTOM BY UTILIZATION OF IODOSTARCH REACTION. Fujita, S.; Miyata, N. (Nagoya City Univ., Japan). Nippon Igaku Hoshasen Gakkai Zasshi; 34: No. 1, 44-49(Jan 1974). (In Japanese).

A solid dosimetric phantom using the chemical reaction with iodostarch which gives a three-dimensional dose distribution is described. In order to increase the sensitivity against radiation chloral hydrate and sodium chloride were added to potassium iodide-starch system. A definite quantity of the sample solution (8 ml) was placed in a test tube and irradiated with ^{60}Co γ-rays. After irradiation the absorbancy of the solution was measured immediately by spectrophotometer (Hitachi 101; cell, $10 \times 10 \times 40$ mm^3). Suitable concentrations of potassium iodide, starch, chloral hydrate, and sodium chloride were 0.01 M, 0.3 g/l, 0.1 and 0.1 M respectively. The solution was examined for temperature dependency (7-40°C) and percentage depth-dose in water phantom (2-20 cm). Subsequently agar was used to form a gel of the solution in a container of acrylic resin ($20 \times 20 \times 20$ cm^3). The container was placed on the table and irradiated by γ-ray beam (10×10 cm^2). Sensitivity of the solution depended on the temperature and the sensitivity decreased with increasing temperature. The error, however, was within 5% in the temperature range 7-30°C. Percentage depth dose in water phantom was approximately the same value as in ionizing chamber (Radocon 1, probe type 606) above 50%. When the concentration of agar was 0.1-0.15 g/l, a three-dimensional dose distribution was observed with unaided eye from outside of the container. (auth)

22972 SPATIAL DISTRIBUTION OF INTENSITIES AND ADSORBED DOSES OF RADIATION UNDER CONDITIONS OF INEQUILIBRIUM OF SECONDARY RADIATION. Dubinin, I.; Pholova, L. (Katedra Radiologie a Nukleari Mediciny, Brno). Cesk. Radiol.; 27: 415-419(Nov 1973).

The work derives general analytical term for space distribution of intensities and absorbed doses of radiation under conditions of inequilibrium of its secondary constituent. It is based on the energy of primary radiation emitted by the source and on the energy of secondary radiation, emitted by elementary volume of absorption environment during the absorbtion of the primary radiation. The spreading as well as absorption are considered for both constituents. The problem is discussed for the spot source of radiation, situated inside and outside the absorbtion environment. There are also mentioned the possibilities of solution for linear plane as well as volume source of radiation and solution for environment with nonhomogenous absorbtion. (auth)

22973 EMERGENCY SAVING OF PATIENTS WITH REGARD TO UNWANTED SECONDARY RADIATION FROM GAMMA-RAY TELETHERAPY UNITS IN THE IRRADIATION ROOM. Quast, U. (Essen Univ. (Gesamthochschule) (F. R. Germany). Abt. fuer Klinische Strahlenphysik). Strahlentherapie; 147: No. 1, 47-57 (Jan 1974). (In German).

10 figs.; 23 refs.

Gamma-ray teletherapy units are used in the percutaneous radiotherapy with increasing frequency. This means an increasing risk of emergency situations: if the shutter of the radiation source fails, the patient must be saved from the radiation field of the disturbed apparatus. To appraise the radiation exposure of the saving staff, the local dose rates of the unwanted secondary radiation in the height of the gonads were measured in two gamma irradiation rooms, for four different situations of standard irradiation and for different field sizes. The local isodoses are specified in relation to the reference dose rates of the ^{60}Co or ^{137}Cs source. Although the values of the dose rate behind the patient may be up to 2.5 mW/kg (900 rem/h), it is possible to save the patient without exceeding a gonad dose of 1 mJ/kg (100 mrem). For this purpose though, accurate knowledge of the actual local isodoses and the available saving equipment is necessary. Urgent measures for saving of patients within an emergency plan are discussed by an exampled. (auth)

22974 SCHEMATIZED ISODOSE PICTURES FOR THE ARRANGEMENT OF PENDULUM IRRADIATIONS IN DEEP ^{60}Co THERAPY. P. 3. Biaxial Pendulum Irradiations. Roedel, K. (Giessen Univ. (F. R. Germany). Zentrum fuer Radiologie). Strahlentheraphie; 147: No. 2, 177-184(Sep 1974). (In German).

6 figs.; 5 refs.

A method is described for developing a treatment plan with biaxial pendulum irradiations by means of the isodose pictures developed for monoaxial pendulum irradiation. The position of both pendulum axes, the included focal region and information concerning the exposure of neighboring organs are obtained by shifting two isodose schemata above the patient's cross section picture. By the examples of biaxial pendulum irradiations of the paraaortal lymph nodes and the biaxial pendulum irradiation of the renal area the simple arrangement, the resulting isodose pictures and the diagrams for the determination of the absolute dose are demonstrated. By the example of the renal pendulum irradiation, the compensation of different pendulum angles and field widths with asymmetrical position of the axes in the cross section were demonstrated by the choice of the rotation numbers. (auth)

22975 DOSE DISTRIBUTIONS MODIFIED BY NARROW-FIELD SCANNING METHOD IN HIGH-ENERGY ELECTRON-BEAM THERAPY. Ueda, T.; Kimura, C. (Aichi Cancer Center, Nagoya (Japan). Dept. of Radiation Therapy). Strahlentherapie; 147: No. 2, 185-188(Feb 1974).

4 figs.; 11 refs.

Dose distributions were modified by narrow-field scanning of high-energy electron beam. During scanning, the energy of electron beam was shifted from 10 to 16 MeV, or from 20 to 31 MeV, automatically as planned. Depth of the treatment area (90 or 80% region) was changed at different positions in an irradiated field. Depth dose curves and isodose curves obtained by this method showed to be improved when compared with those obtained by absorber technique. (auth)

22976 STOPPING POWER OF SOLIDS FOR LOW-VELOCITY CHANNELLED HEAVY IONS. Briggs, J. S.; Pathak, A. P. (Atomic Energy Research Establishment, Harwell, Eng.). J. Phys., C (London); 7: No. 11, 1929-1936(7 Jun 1974).

A model of the stopping of a low-velocity heavy ion moving through an electron gas is used to calculate the stopping power of solids for channelled heavy ions. The heavy ion is considered to lose energy by transferring momentum to target electrons which scatter elastically from it, so that the stopping cross section is proportional to the momentum-transfer cross section. This cross section varies periodically with the Z_1 of the incident ion, the periodicity being shown to be connected with the successive filling of atomic sub-shells of electrons. The model is applied to the stopping power of silicon for ions channelled along the ⟨110⟩ and ⟨111⟩ directions and good agreement is obtained with the data of Eisen (Can. J. Phys.; 46: 561 (1968)). A feature of this approach is the reproduction of deep minima in channelled stopping power in certain regions of the periodic table. (auth)

22977 SEMI-AUTOMATIC DEVICE FOR DOSIMETRIC MEASUREMENTS IN A PHANTOM. Rytina, K. (Inst. of Plasma Physics, Prague). Cesk. Radiol.; 27: No. 2, 125-128(Mar 1973). (In Czech).

A device for measuring isodose curves in a water phantom is briefly described. The measurement of the course of ionization in various planes of the water phantom was used for constructing isodoses. The ionization chamber signal was recorded using a planar coordinate recorder. The position of its recording stylus was determined by two coordinates X-Y of which one was proportional to the chamber position in one of the three coordinates of the water phantom while the other was proportional to the ionization chamber signal. (Nuclear Sci. Abstr. Czech.)

22978 ABSORBED DOSE MEASUREMENTS IN GELATIN. Filimonov, A. Chapel Hill, NC; University of North Carolina (1973). 94p. University Microfilms Order No. 74-15,330.

Thesis (Ph. D.).

Measurements of the specific heat, thermal conductivity, and response to radiation of a four percent gelatin verified that the absorbing medium is calorimetrically equivalent to water. A model was assumed for the temperature profile established by the cobalt-60 irradiation of the gelatin phantom. Calculations showed that heat conduction losses in the medium would produce a maximum 2% error in a calorimetric determination of the dose on the central axis. Calorimetric measurements were made along the central ray, using a Keithley resistance bridge, thermistor, and plotter. The rate of temperature rise was converted to an absorbed dose rate. The total uncertainty in the determination of the absorbed dose was estimated at 4%. Agreement of the experimental depth doses with the expected doses, on the basis of ionization chamber measurements, was good ranging from 1 to 6%. This work demonstrated the feasibility of using a calorimetric technique to measure depth doses in a large absorber with a low thermal conductivity, in contrast with the conventional technique requiring a small absorbing mass with a high thermal conductivity. (Diss. Abstr. Int., B)

22979 METHOD FOR HIGH REPRODUCIBILITY THERMOLUMINESCENT DOSIMETRY MEASUREMENT OF DEPTH DOSE

IN THERAPEUTIC ELECTRON BEAMS USING TISSUE PHANTOMS. Kendall, W. F. Chapel Hill, NC; University of North Carolina (1973). 161p. University Microfilms Order No. 74-15,355.

Thesis (Ph. D.).

High resolution evaluation of the depth dose distribution and transition zone effects of specific therapeutic high energy electron beams using material readily available to typical radiation therapy departments has been made practical. The procedures developed were vindicated using ^{60}Co gamma radiation and by comparison with independent studies of the same electron beam. Uncertainties of measurements made using tissue-like-materials were circumvented by using actual tissues in exposure phantoms. Evaluations performed confirmed that skin sparing can be achieved with high energy electron beams by increasing the separation between the end of the collimator and the skin surface. No significant perturbation in the depth dose profile in soft tissues by inhomogeneities such as ribs was found down to the 2 mm level of resolution. Methodology for achieving 1% or better reproducibility with powdered thermoluminescent phosphor and a modified commercial thermoluminescent dosimeter reader were developed. The details of methods and procedures are reported. (Diss. Abstr. Int., B)

22980 INTERACTION OF RADIATION WITH MATTER. Ursu, I. (Institutul de Fizica Atomica, Bucharest). pp 161-182 of Energia Atomica. Bucharest; Editura Stiintifica (1973). (In Russian).

Chapter 6 of the book "Atomic Energy" deals with the interaction of radiation with matter. The processes that occur at the penetration of radiations in matter, both having an electric charge (α, $\beta\pm$, protons, heavy ions) and without electric charge (X, γ, neutrons), are studied. Furthermore, there are also presented the modifications undergone by the medium as a consequence of its interaction with the incident radiation, as well as the experimental methods of the irradiation defects. (INIS)

22981 CALCULATION OF THE CHARACTERISTICS OF BACKWARD GAMMA RADIATION FROM TARGETS BOMBARDED WITH ELECTRONS. El'tekov, V. A.; Dubovoi, E. I.; Lim, T. S.; Nadtochii, V. G. Sov. J. At. Energy (Engl. Transl.); 33: No. 5, 1067-1068(Nov 1972).

Translated from At. Energ. (USSR); 33: No. 5, 919-920(Nov 1972). This is a summary of paper No. 626/6754 with full copy held at TIC.

The Monte Carlo method has been used to simulate the production of gamma radiation by bombarding aluminum, iron, tin, and lead targets with a monoenergetic beam of electrons with energies of 10, 30, and 100 MeV. The spectral characteristics of the gamma radiation escaping from a semiinfinite target into the rear hemisphere, together with the yield of backwardly directed photons as a function of the target thickness were obtained. (MHR)

22982 NUCLEAR MATTER AND MATRIX OF LIFE. On the Interaction of High-Energy Physics with Biomedical Science. Larsson, B. (Univ. of Uppsala). pp 451-455 of High-Energy Physics and Nuclear Structure. Tibell, G. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973). See CONF-730642-.

The interaction of high-energy particle beams with living matter is briefly reviewed from the point of view of experimental biology. Theoretical considerations as well as reported experimental and clinical findings support the view that such radiations do not differ, qualitatively, in their biological effect on the microscopic level as compared to more easily available radiations of lower energy. This means that common, simple parameters describing the temporal and spatial distribution of energy determine the primary chemical and cellular effects of irradiation. High-energy radiations thus become of particular interest in research and applications concerning multicellular systems (including higher plants and animals) where macroscopic distribution of dose enters as a third, most significant, physical parameter. The main interest of the high-energy radiations is now associated with their use in general biology and clinical medicine as tools for precise probing or treatment of structures difficult to access. (auth)

22983 INVARIANT IMBEDDING AND RADIATION DOSIMETRY. VIII. Reflection Function from a Double Layer: Finite Order Functions. Bellman, R. (Univ. of Southern California, Los Angeles); Ueno, S.; Vasudevan, R. Math. Biosci.; 20: No. 3/4, 299-314(Aug 1974).

In computing the total reflection function for two media of given scattering properties adjoined together, the usual techniques require a knowledge of reflection and transmission functions of both the media. An alternate method developed here depends only on solving a Riccati equation with suitable initial conditions. By following this procedure, it is possible to calculate the reflection function of a given finite order, for a particle that has suffered a specified number of scatterings in the two portions of the total medium. Such calculations may be useful in radiation dosimetry problems where the body to be irradiated is placed on reflecting materials. (auth)

22984 INVARIANT IMBEDDING AND RADIATION DOSIMETRY. IX. Inverse Problem of Determining a Plane Source in a Finite Isotropically Scattering Target Slab. Bellman, R. (Univ. of Southern California, Los Angeles); Fymat, A. L.; Ueno, S.; Vasudevan, R. Math. Biosci.; 20: No. 3/4, 315-325(Aug 1974).

Considering a homogeneous, isotropically scattering target slab of optical thickness x, containing an internal plane emitting source, the aim here is to determine the distribution of the internal emitting source by measuring the angular distribution of the intensity of radiation emergent from the slab. First, a system of differential recurrence relations for the intensity of finite order scattered radiation emergent from the top is deduced. In other words, a Cauchy system for determining the finite order emergent intensity is expressed in terms of a source function in the diffuse radiation field and the Fredholm resolvent that were computed in a preceding paper [cf. Bellman, Ueno, and Vasudevan, Math. Biosci.; 15: 195-203(1972)]. Then, the quasilinearization technique is used to solve the inverse problem of determining characteristics of the internal source by measuring the radiation field emergent from the top. This method will be employed in future computations relating to realistic situations in the radiation diagnosis and therapy. (auth)

22985 EFFECT OF HUMIDITY ON THE IONIZATION POWER OF X OR γ RADIATION IN AIR. Guiho, J. P.; Pavlicsek, L.; Ostrowsky, A.; Goenvec, H. (CEN de Saclay, Gif-sur-Yvette, France). Compt. Rend., Ser. B; 278: No. 3, 69-71(14 Jan 1974).

Measurements were made on the ionization of air by x and γ radiation. It was shown that the presence of small quantities of water vapor considerably increases the ionization. The law established for the ionization as a function of humidity is quite different from that generally used and predicted by the theory. The effect of this phenomenon on the measurements made is analyzed. (FR)

22986 RADIOLOGIC TECHNOLOGY: A FUTURE FOR YOU. Jackson, T. J. New York; Tiresias Press, Inc. (1974). 123p. $3.95.

An attempt is made to give information about the past, present, and future of radiologic technology as a career. It was written for those who have little acquaintance with the field but who are interested in it and want to know about the opportunities it offers. (MHK)

22987 FORMULA FOR THE COMPUTATION OF THE CROSS SECTION FOR γ-QUANTA PAIR PRODUCTION IN THE STATISTICAL MODELLING OF TRANSPORT PROCESSES. Marenkov, O. S. Sov. At. Energy (Engl. Transl.); 35: No. 3, 858-859(Sep 1973).

Translated from At. Energ. (USSR); 35: No. 3, 209-201(Sep 1973).

In the statistical modeling (by the Monte Carlo method) of the transport in matter of γ quanta of medium and high energy, two elementary interaction processes are usually considered--incoherent scattering and electron-positron pair production. As there is no suitable formula for the computation of the integral cross section for the photon pair production, the cross sections are usually tabulated; however, this is incovenient for numerical computation. A simple function was used to circumvent this problem. Coefficients for the function are tabulated for 48 elements. (RWR)

22988 APPROXIMATE CALCULATION OF THE BACKSCATTER OF GAMMA RADIATION AT SPECIAL GEOMETRY. Kubicek, P. (Inst. of Mining and Metallurgy, Ostrava, Czech.). Jad. Energ.; 20: No. 6, 191-199(Jun 1974). (In Czech).

A simple and double Compton scatter and a simple Rayleigh scatter are calculated provided that the collimated monoenergetic gamma-ray beam is impinging perpendicularly to the scattering environment and the detector is located in the axis of beam. To evaluate the theory some programs have been compiled for a computer. The theory is illustrated with several numerical calculations of the double scatter and is compared with the simple back scatter. (auth)

Radiation Protection Standards

Refer also to abstracts 21069, 21267, and 21361.

22989 (AEC-tr-7553) SOME CONSIDERATIONS ON THE UNITS USED IN RADIATION PROTECTION DOSIMETRY. Rindi, A.; Thomas, R. H. Translated by M. C. Rindi from G. Fis.

Sanit. Prot. Radiaz.; 16: No. 4, 177-183(1972). 11p. Dep. NTIS $4.00.

The complexities involved in meeting all the criteria necessary for an exact determination of dose equivalent and the necessity of evaluating measurements expressed in other units are discussed. The historical origins of the dosimetric units in current use are discussed. These units are individually analyzed, and finally, a method of expressing the dose equivalent due to exposure to radiation environments is discussed. (MHR)

22990 ACTIVITIES OF THE RADIATION PROTECTION GROUP. Brandschutz; No. 7, 205-206(1973). (In German). 2 figs.

A description is given of the activities of a radiation protection group in order to recover radioactive materials from cellar rooms flooded by rain water. (GE)

22991 NEW RADIATION PROTECTION REGULATION FOR THE OPERATION OF X-RAY EQUIPMENTS AND ELECTRON ACCELERATORS. Berger, H. (Siemens A. G., Erlangen (F.R. Germany). Unternehmensbereich Medizinische Technik). Electromedica; No. 3, 143-144(1973). (In German). 10 refs.

Personnel and organizational consequences of the new German Federal Republic X-ray regulation, which came into force Sept. 1, 1973 are discussed. (GE)

22992 RULES CONCERNING THE OPERATION OF MEDICAL ACCELERATOR EQUIPMENT. Stieve, F. E. (Bundesgesundheitsamt, Berlin (F.R. Germany)). Strahlentherapie; 147: No. 2, 201-210(Feb 1974). (In German). With refs.

The committee of the Laender for nuclear energy has set up a number of rules relating to the operation of accelerator equipment in medicine. These rules are based upon the recommendations of a medical subcommittee and those given by the Federal Ministry of Health. According to the decree issued by the Federal Minister of the Interior, the Laender authorities responsible for the implementation of paragraph 19 Atomic Energy Law are requested to supervise the operation of accelerator facilities in medical undertakings and to issue appropriate operating instructions in accordance with the above-mentioned rules. These rules are of importance for everybody in the medical field working with accelerators, especially radiotherapists, physicists and medical personnel. They are published with the consent of the Federal Minister for the Interior. (GE)

22993 RADIATION DOSE LIMITS. Butler, G. C. (National Research Council of Canada, Ottawa). pp Paper No. CNA'73-302 of Proceedings of the Thirteenth Annual International Conference of the Canadian Nuclear Association. Toronto; Canadian Nuclear Association (1973).

From 13th annual international conference of the Canadian Nuclear Association; Toronto, Ontario (17 Jun 1973).

Concepts and procedures for assessing radiation dose limits to whole populations and to individuals are reviewed. On the global scale, the concept of dose commitment, employed by the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), is outlined. On the individual level, the concepts of the "standard man" and life of the "critical group," developed by the International Commission on Radiological Protection (ICRP), are examined. Estimates of the risks per unit of radiation against which man is to be protected are discussed in terms of acute effects and late effects. Criteria for "acceptable risk," based on dose limits recommended by ICRP and UNSCEAR, are presented. (GWC)

22994 STATE SPECIAL STANDARD OF THE UNIT OF CONCENTRATION OF ARTIFICIAL AND NATURAL RADIOACTIVE AEROSOLS. Antipin, N. I.; Borunova, E. P.; Dokukina, V. L.; Kolerova, O. N.; Kolerskii, S. V.; Kravchenko, I. I.; Kuznetsov, Yu. V.; Lekhtmakher, S. O.; Ruzer, L. S.; Stepanova, L. G. Meas. Tech. (USSR) (Engl. Transl.); 16: No. 12, 1788-1792 (Dec 1973).

Translated from Izmer. Tekh.; 16: No. 12, 24-26(Dec 1973).

The laboratory of radioactive aerosols at VNIIF TRJ has been working on the development of new spectrometric methods, apparatus, and special radiation sources, spectrometric measuring transducers, and radioactive aerosol generators, which have greatly increased the accuracy of measuring the concentration of radioactive aerosols. Several of these developments are discussed. (MHR)

Radiation Source Calibration and Standardization

Refer also to abstract 21207.

22995 ROUTINE DETERMINATION OF ^{60}Co STANDARD EXPOSURE AS A CONTROL OF THE SYSTEM RADIATION SOURCE-MECHANICS-DOSIMETER. Eipper, H. H. (Staedtisches Krankenhaus Koeln-Merheim (F.R. Germany). Roentgeninstitut und Strahlenklinik). Strahlentherapie; 147: No. 2, 189-200(Feb 1974). (In German).

5 figs.; 2 tabs.; 10 refs. Also published as AED-CONF-73-482-003.

By routine measurements of the so-called "Roentgenwert" (dose rate) of a ^{60}Co irradiation rig, possible failures can be detected. The 5% accuracy attained is near the tolerance limit as an error in connection with radiotherapy and personnel dosimetry. Therefore, additional checks are necessary. (GE)

Shielding Calculations and Experiments

22996 (ORNL-TM-4648) VEHICLE CODE SYSTEM (VCS) USER'S MANUAL. Rhoades, W. A.; Emmett, M. B.; Morrison, G. W.; Pace, J. V. III; Petrie, L. M. (Oak Ridge National Lab., Tenn. (USA)). Aug 1974. Contract W-7405-eng-26. 76p. Dep. NTIS $7.00.

The Vehicle Code System calculates radiation protection factors for armored military vehicles by coupling a forward discrete ordinates air-transport calculation with an adjoint Monte Carlo treatment of the vehicle geometry. Efficiency and moderate use of computer time are emphasized. The code system includes special versions of the DOT III and MORSE codes, together with peripheral codes as required. The user's manual includes notes describing the input format and sample input listings for each code. (auth)

22997 (ZJE-127) SOLUTION OF RADIATION TRANSPORT IN SHIELDING BY THE ANALYTICAL METHOD USING FUNCTIONS OF MATRIX ARGUMENT. Valenta, V. (Skoda, Plzen (Czechoslovakia)). 1972. 79p.

The analytical solution is presented of gamma and neutron transport in shielding by the S_N method, without iterations, using the matrix functions for a slab geometry. Different methods for integrating the scattering term are discussed. A close relation is shown to the method of transmission and reflection based on the invariance principle. The possibility is pointed out of extending the suggested system for geometries with the axis symmetry using a method based on the determination of the characteristics of differential part of the kinetic equation operator. The relationship to the solution of Boltzmann equation by means of the Lie series is also shown. (Nuclear Sci. Abstr. Czech.)

PHYSICS (THEORETICAL)

General

Refer also to abstract 23494.

22998 (INFN/AE-73/7) SPECIAL RELATIVITY EXTENDED TO SUPERLUMINAL FRAMES AND OBJECTS (CLASSICAL THEORY OF TACHYONS). Mignani, R.; Recami, E. (Istituto Nazionale di Fisica Nucleare, Rome (Italy)). 15 Nov 1973. 67p. Dep. NTIS (US Sales Only) $6.50.

A review is given of the classical theory of superluminal objects. The so-called "causal paradoxes" are also investigated and clarified. Particular attention is paid to the symmetries required by extended relativity: for example, the crossing relations and the CPT theorem are derived. (LBS)

22999 (ITF-74-20E) GENERAL CONCEPT OF QUANTIZATION. Berezin, F. A. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1974. 28p. Dep. NTIS (US Sales Only) $4.50.

The general definition of quantization is proposed. As an example two classical systems are considered. For the first of them the phase space is a Lobachevskii plane, for the second one the two-dimensional sphere. (auth)

23000 (ITF-74-34E) GENERALIZED MOMENT PROBLEM. Yatsun, V. A. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1974. 18p. Dep. NTIS (US Sales Only) $4.00.

The generalized moment problem is considered which arises under analyzing the Gribov-Froissart formula for the partial amplitudes. The necessary and sufficient conditions of solvability of the problem by reducing it to the power problem are obtained. (auth)

23001 (ITP-74-26E) CRITERION OF ESSENTIAL SELF-ADJOINTNESS OF OPERATORS. Yakymiv, Ya. M. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1974. 11p. Dep. NTIS (US Sales Only) $4.00.

The problem of essential self-adjointness of symmetric operators and a sum of two symmetric operators one of which is self-adjoint and positive is investigated. The following theorem is a main result of the paper. Let $H = H^* \geq 0$ and A be the symmetric operator in the Hilbert space H and there exist such positive numbers k, n, m, l where n, $m < l - \epsilon$ and ϵ is a sufficiently small positive number that the following conditions: $\|AR^k\| + \|[H,A]R^k\| < \infty$, $\|R^n (adH)^l (A)R^m\| < \infty$ are fulfilled. Then the operators A and H + A are essentially self-adjoint. (auth)

23002 (KHFTI-72-45, pp 67-68) IMPROVEMENT IN THE LOCAL VARIATION METHOD. Trushnikov, V. N.; Sablin, N. I. (Tomsk Polytechnic Inst., USSR). 1972. (In Russian).

The advantages and disadvantages of the local variation method are discussed. With the purpose of improving the method the conditions for the convergence of the iterating process were obtained and a selection of the original step was made. (tr-auth)

23003 COMBINATORIAL ASPECTS OF BOSON ALGEBRA. Katriel, J. (Technion-Israel Inst. of Tech., Haifa). Lett. Nuovo Cim.; 10: No. 13, 565-567(27 Jul 1974).

Some results concerning the normal-ordering of certain classes of operators are presented. Furthermore, expansions in terms of the number operator are considered. The role of combinatorial analysis in the area discussed is exhibited. (LBS)

23004 ORIGIN OF THE QUANTUM CONCEPTS. Syros, C. (European Atomic Energy Community, Brussels). Lett. Nuovo Cim.; 10: No. 16, 718-722(17 Aug 1974).

The origin of the fundamental concepts of quantum mechanics is discussed: uncertainty relations, commutation relations, physical meaning of the phases of the density matrix and relationship between spin and statistics. (LBS)

23005 INTEGRATING PRODUCTS OF DISPLACED SHO WAVE FUNCTIONS. Bergmann, E. E. (Lehigh Univ., Bethlehem, PA). Nuovo Cim.; 22B: No. 2, 249-260(11 Aug 1974).

Integrals of products of n-dimensional, displaced, simple harmonic-oscillator (SHO) wave functions are evaluated. Each of the p different wave functions may be displaced in both representation and momentum space. Each SHO wave function may be an eigensolution of a different integral or differential equation. These integrals occur in quantum mechanics, coherent optics and nonlinear optics. In addition, the notation and formalism introduced in this work may prove useful in other areas of mathematical physics. A more powerful and versatile alternative to the Einstein summation convention is provided. The coherent-state representation of Glauber is adapted to the discussion of the above integrals. (auth)

23006 TWO INTERPRETATIONS OF QUANTUM MECHANICS. I. Weingarten, D. (Univ. of Copenhagen). Nuovo Cim.; 22B: No. 2, 293-327(11 Aug 1974).

The Copenhagen interpretation of quantum mechanics is analyzed, and the consequences of a class of assumptions which form a crucial part of this theory but are not usually discussed explicitly are examined. The assumptions referred to could be described as "metaphysical assumptions." It might seem that physical theories should not use ideas with this name but one tries to show that every physical theory appears to incorporate some assumptions of this kind. In practice the metaphysical assumptions which a theory does use seem to be chosen by imposing a number of requirements two of which could be roughly described as "simplicity" and "believability." But it is shown that the metaphysical assumptions of the Copenhagen interpretation generate a collection of difficulties and as a result do not appear to fulfil these conditions. (auth)

23007 ACCURACY OF LOWER BOUND FORMULAE FOR EIGENVALUES. Cohen, M.; Feldmann, T. (Hebrew Univ., Jerusalem). J. Phys., B (London); 7: No. 7, L210-L211(11 May 1974).

The relative error in a lower bound formula given previously by the authors (Cohen and Feldmann, Can. J. Phys.; 47: 1877-9 (1969)) is shown to approach zero more rapidly than the corresponding error of the Rayleigh upper bound. (auth)

23008 LIE GROUPS, LIE ALGEBRAS, AND SOME OF THEIR APPLICATIONS. Gilmore, R. New York; John Wiley and Sons, Inc. (1974). 605p. $24.95.

The topics discussed include the classical groups, some simple examples, classical algebras, Lie algebras and root spaces, root spaces and Dynkin diagrams, real forms, and contractions and expansions. (JFP)

23009 LECTURES IN MATHEMATICAL PHYSICS. Volume II. Hermann, R. Mathematics Lecture Note Series. Reading, MA; Addison-Wesley/W. A. Benjamin, Inc. (1972). 765p. $17.50.

The topics covered are Dirac spaces and generalized functions, groups and their representations, the Feynman path-integral approach to quantum mechanics, scattering theory, statistical mechanics, and quantum field theory. (JFP)

23010 SELF-TRAPPING ANALOGY OF NONLINEAR FIELD THEORIES OF MATTER. Olsen, S. O. (Norwegian Defense Research Establishment, Kjeller). Lett. Nuovo Cim.; 10: No. 16, 689-692(17 Aug 1974).

The similarity between self-trapping of laser light in dielectrics and the creation of matter particles in the vacuum is pointed out. Some consequences resulting from the analogy are discussed, and an experiment to study the propagation and interactions of such model elementary particles is suggested. (LBS)

23011 CONTINUITY CONDITION FOR INTERNAL SYMMETRY GROUP. Bulinskii, A. V. (Moscow Physical-Technical Inst.). Teor. Mat. Fiz.; 19: No. 3, 300-304(Jun 1974). (In Russian).

The weak continuity condition is inapplicable for internal symmetry group if local algebras are supposed to be the W*-algebras. (auth)

23012 INTEGRAL EQUATION FOR MANY-BODY GREEN'S FUNCTION. Hellal el Hasene. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 15: No. 1, 36-43(1974). (In Russian).

By means of regularizing a "limiting representation" an infinite set of equations are constructed that do not contain any infinite constants of renormalization, whose solution leads to regularized values for multiparticle Green functions. This set of equations is an equivalent to the Schwinger equations in variational derivatives. However, this set of equations differs from the Schwinger equations in the fact that although it also is a set of equations for renormalized values, no infinite coefficients figure in it. (SJR)

Quantum Field Theories

Refer also to abstracts 22318, 22334, 22362, 22404, 22407, 22418, 22420, 22444, 23001, and 23009.

23013 (DESY-74/15) INVARIANCE OF THE S-MATRIX UNDER POINT TRANSFORMATIONS IN RENORMALIZED PERTURBATION THEORY. Flume, R. (Deutsches Elektronen-

Synchrotron (DESY), Hamburg (F. R. Germany)). Apr 1974. 8p. Dep. NTIS (US Sales Only) $4.00.

A simple proof is given of the invariance of the S-matrix under point transformations of the fields in renormalized perturbation field theory. (auth)

23014 (ITF-74-54E) EUCLIDEAN FERMI FIELDS AND GREEN FUNCTIONS WITHOUT MOMENTUM CUTOFF IN THE YUKAWA$_2$ FIELD THEORY. Rebenko, A. L. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1974. 32p. Dep. NTIS (US Sales Only) $4.75.

It is shown that Euclidean Fermi fields appear in the perturbation theory for S-matrix as creating and annihilating operators of lines for Feynman diagrams in the Euclidean region. The connection between the generating operator of these diagrams and total Yukawa$_2$ Hamiltonian is established. The existence of Green functions without momentum cutoff is proved. For sufficiently small coupling constant Gell'Mann–Low formula is also established. (auth)

23015 (ITF-74-31P) FOURIER TRANSFORMATION OF HYPERFUNCTIONS AND FORMULATION OF THE BASIC AXIOMS AND THE QUANTUM FIELD THEORY PRINCIPLES IN TERMS OF HYPERFUNCTIONS. I. Romanko, G. D.; Khimich, I. V. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1974. 29p. (In Russian). Dep. NTIS (US Sales Only) $4.50.

To formulate the axiomatic local quantum field theory it is suggested to use the theory of hyperfunctions. The class L of hyperfunctions which are local in the coordinate and the momentum spaces is introduced. The direct and the inverse Fourier transformation of the hyperfunctions of the class L is defined and the connection of these hyperfunctions with generalized functions of S_1' is established. With the help of the notion of the hyperfunction support, the local commutativity is formulated within the localizable field theories. (auth)

23016 (ITF-74-33P) DYNAMIC MASS SPLITTING IN TWO-FERMION ELECTRODYNAMICS WITH SPONTANEOUSLY BROKEN SYMMETRY. Fomin, P. I.; Shapovalov, V. V. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1974. 28p. (In Russian). Dep. NTIS (US Sales Only) $4.50.

On the basis of functional renormalization relations and partial use of perturbation theory, the asymptotics of Green's functions and renormalization constant in two-fermion electrodynamics with spontaneously broken chiral and isolepton symmetries are calculated in a so-called "five-vertex" approximation. In this approximation the equations for lepton masses are deduced and analyzed. It is shown that in the considered scheme with partial vacuum degeneration in leptonic isospin the dynamic mass splitting of leptons (electron-muon) arises under the condition $m_0 < 0$ (m_0-bare mass) and vanishes when $m_0 \geq 0$. (auth)

23017 (ITF-74-38P) EQUIVALENCE THEOREM AND REGULARIZATION IN QUANTUM FIELD THEORY. Mogilevskii, O. A.; Rutenberg, M. L. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1974. 15p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

A model is suggested in the framework of which the possibility of proving the equivalence theorem with regularization, violating the equality reg S = reg S', is investigated. It is shown that the use of such a regularization leads to violating the equalities of the finite S-matrices (that is connected with the non-renormalization of theories). (auth)

23018 (ITF-74-39P) NON-LOCAL QUANTUM ELECTRODYNAMICS OF THE SPIN S = 3/2. Mogilevskii, O. A. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1974. 29p. (In Russian). Dep. NTIS (US Sales Only) $4.50.

The non-local quantum electrodynamics of particles with the spin S = 3/2 is constructed by means of generalizing a local gradient group. The algorithm of calculating the Feynman diagram is formulated in any order of perturbation theory, the S-matrix satisfies in either order in coupling constant all the required properties: finiteness, unitarity, causality, covariance, gauge invariance. (auth)

23019 (JINR-P2-7995) MODIFIED DIRAC EQUATION IN QUANTUM FIELD THEORY. Dul'yan, L. S.; Faustov, R. N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 20p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

We consistently consider a version of the quasipotential approach in quantum field theory when one of the two particles of a bound system is transferred on the mass shell. Thereby, it is possible to obtain the modified Dirac equation which takes into account the movement of both the particles. An approximate solution of this equation is found in the case of the Coulomb potential. (auth)

23020 S-MATRIX IN QUANTUM ELECTRODYNAMICS WITH EXTERNAL FIELD. Nikishov, A. I. (Lebedev Inst. of Physics, Moscow). Teor. Mat. Fiz.; 20: No. 1, 48-56(Jul 1974). (In Russian).

Neglecting the radiation field, the evolution operator is expressed in terms of solutions of the Dirac equation. In general, the creation and destruction operators defined for $t \to -\infty$ differ from those defined for $t \to \infty$ and are related by the Bogoliubov transformation; initial and final vacuum states are also different. Introduction of unitary operator corresponding to the Bogoliubov transformation permits to refine the Feynman proof of equivalence of his theory of positrons and the secondary quantized theory. (auth)

23021 REDUCTION OF PROBLEM OF EVALUATING A CLASS OF INFINITE-MULTIPLICITY INTEGRALS IN QUANTUM FIELD THEORY TO SOLVING THE INTEGRAL EQUATION. Zastavenko, L. G. (Joint Inst. for Nuclear Research, Dubna, USSR). Teor. Mat. Fiz.; 20: No. 1, 57-65(Jul 1974). (In Russian).

A method is proposed for reducing the problem of evaluating the infinite-multiplicity integrals to the solution of the integral equation. The formalism constructed is applied to calculation of the two-particle Green function with the aid of the Feynman integral. (auth)

23022 POINT SOURCE OF MASSIVE SCALAR FIELD IN GENERAL RELATIVITY. Asanov, R. A. (Joint Inst. for Nuclear Research, Dubna, USSR). Teor. Mat. Fiz.; 20: No. 1, 66-70 (Jul 1974). (In Russian).

A numerical static solution to point source of massive scalar field in general relativity is given. The simplest generalization of scalar field equation is used. Like the massless field case, no horizon occurs and there is an essential singularity in the vicinity of the source. (auth)

23023 POSITION OPERATOR AND ELECTROMAGNETIC INTERACTIONS IN DIRAC'S POSITIVE ENERGY THEORY. Photinos, D. J.; Morol, D. S. (Kent State Univ., OH). Lett. Nuovo Cim.; 10: No. 15, 637-640(10 Aug 1974).

A consistent, gauge invariant generalization of Dirac's positive-energy wave equation that includes the electromagnetic interactions is presented. It is shown that there is a connection between the possibility of introducing such interactions and the properties of the position operator of the free particle. (LBS)

23024 SCATTERING OF PARTICLES TAKING INTO ACCOUNT THE INTERACTION WITH QUANTIZED SCALAR FIELD. Tyurin, N. E.; Khrustalev, O. A. (Inst. of High Energy Physics, Serpukhov, USSR). Teor. Mat. Fiz.; 20: No. 1, 3-17(Jul 1974). (In Russian).

A system including two particles and a quantized scalar field is considered. The interaction includes the potential part and the essentially quantum part (linear with respect to the field). Influence of the quantum interaction effects on the scattering of particles is discussed and processes including the production of field quanta are considered. In the case of the non-weak coupling of particles to the field the model proposed leads naturally to acquiring structure by the particles, the properties of the structure being determined by the character of the interaction between the particles. Important role in the study is played by the form factor of particles, which enters the expressions for the characteristics of elastic scattering with the emission of field quanta. Recoil effects at the radiation of the field quanta are taken into account. Possible generalizations of the model are discussed. (auth)

23025 FEYNMAN AMPLITUDE AND MEYER G-FUNCTION. A Unified Representation for Divergent and Convergent Graphs. Kucheryayi, V. I. (Inst. of Theoretical Physics, Uzhgorod, USSR). Teor. Mat. Fiz.; 20: No. 1, 29-47(Jul 1974). (In Russian).

The parametric α-representation of the Feynman amplitude for spinor graphs, which is expressed in terms of the Meyer G-function, is obtained. This representation holds in the same form both for divergent and convergent graphs. The known Chisholm–Nakanishi–Symanzik representation for convergent scalar graphs turns out to be a special case of the formula derived. In addition, the expression possesses a number of useful features: (1) this representation reveals that the mathematical nature of infrared divergences considered usually as associated only with zero photon mass is the same as that of the singularities of the Feynman amplitude which has no such particles; (2) the expression has the form in which the scale invariant terms are explicitly separated from the terms breaking this invariance; (3) the expression preserves gauge invariance and the Ward identity for renormalized amplitudes, as demonstrated by an example of the simplest graphs in quantum electrodynamics. (auth)

23026 QUANTUM DYNAMICS OF A MASSLESS RELATIVISTIC STRING. Patrascioiu, A. (Inst. for Advanced Study, Princeton, NJ). Lett. Nuovo Cim.; 10: No. 15, 676-680(10 Aug 1974).

The quantum mechanics of a massless relativistic string is studied, following the prescription of Goddard, Goldstone, Rebbi and Thorn. It is found that, besides the purely transverse modes of oscillation found by GGRT, the string has also longitudinal modes. Hence there are nontrivial motions of the string in two dimensions. The longitudinal modes restore the Lorentz covariance of the system in any number of dimensions. (LBS)

23027 NONLINEAR CHIRAL DISPERSIVE WAVES. Lakshmanan, M. (Madras Univ.). J. Phys., A (London); 7: No. 8, 889-897(21 May 1974).

Whitham's theory of nonlinear water waves (Proc. R. Soc.; A 283: 238-61 (1965)) is applied to a classical field with the lagrangian density $L = \frac{1}{2}\{[(\partial^\mu\phi)(\partial_\mu\phi) - m^2\phi^2]/(1 + \lambda\phi^2)\}$. This is the isoscalar analog of a chiral invariant SU(2) ⊗ SU(2) lagrangian with symmetry breaking term included. The corresponding field equation admits simple harmonic plane-wave solutions. It is found that the important field quantities of these waves, namely the wave number k and amplitude A obey a system of first-order partial differential equations. When the coupling parameter λ is negative in sign, the system is hyperbolic, which implies that any inhomogeneities in k and A propagate with certain (amplitude-dependent) velocities. These velocities, which are the nonlinear generalization of the group velocity in the Whitham sense, are calculated. (auth)

23028 CALCULATION OF ANOMALOUS DIMENSIONALITIES IN NON-ABELIAN FIELD GAUGE THEORIES. Belavin, A. A.; Migdal, A. A. (Inst. of Theoretical Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 19: No. 5, 181-182(5 Mar 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 19: No. 5, 317-320(5 Mar 1974).

The Gell-Mann–Low function and the anomalous dimensionalities in non-Abelian gauge theories with large numbers of fermions and bosons are obtained. The existence of a fixed point is proven. (auth)

23029 CANONICAL QUANTIZATION OF CLASSICAL NONLINEAR RELATIVISTIC FIELD THEORY. Balaban, T. (Univ., Warsaw); Jezuita, K.; Raczka, R. Lett. Nuovo Cim.; 10: No. 16, 705-709(17 Aug 1974).

A quantum local relativistic interacting field is constructed by means of the canonical quantization of solutions of a classical nonlinear relativistic wave equation. (LBS)

23030 IDENTITIES IN LAGRANGIAN FIELD THEORY. des Cloizeaux, J. (CEN de Saclay, Gif-sur-Yvette, France). Lett. Nuovo Cim.; 10: No. 13, 552-554(27 Jul 1974).

The Lagrangian in a space of dimension $d = 4 = \epsilon$ is considered. For $\epsilon > 0$, unrenormalized Green's functions are defined, and for $\epsilon \geq 0$, renormalized Green's functions are defined. Identities are then obtained for the Green's functions. (LBS)

23031 RAMAKRISHNAN'S APPROACH TO RELATIVITY. Levinson, N. (Massachusetts Inst. of Tech., Cambridge). J. Math. Anal. Appl.; 47: No. 1, 222-225(Jul 1974).

The Ramakrishnan formulation, in which the relativistic theory is presented as a natural continuance and completion of Newtonian ideas, is modified for convenience by rescaling. The key assumption is that the magnitude of the velocity has an upper limit. (JFP)

23032 CALCULATION OF THE FUNDAMENTAL LENGTH AND THE FINE-STRUCTURE CONSTANT FROM EQUAL-TIME COMMUTATORS. Pradhan, T.; Khare, A. V. (Saha Inst. of Nuclear Physics, Calcutta). Lett. Nuovo Cim.; 10: No. 16, 701-704(17 Aug 1974).

The fundamental length and the fine-structure constant are calculated from equal-time commutators in quantum field theory. The values obtained are $l = 1.37 \cdot 10^{-12}$ cm and $\alpha^{-1} = 128.0$. (LBS)

23033 NEW POSSIBLE COMPOSITE QUANTIZED FIELD THEORY. Ho, T. H.; Huang, T. Wu Li Hsueh Pao; 23: No. 2, 113-152(Mar 1974). (In Chinese).

A new composite quantized field theory is formulated. A bilocal field operator equation of Bethe-Salpeter type with sources is introduced as the equation of motion of composite fields. The bound state field theory of Haag-Nishijima-Zimmermann and the Mandelstam's transition formula of bound state can be shown to be contained in the present theory, some difficulties of their theory being avoided. (JPRS)

23034 ELECTRODYNAMIC DETERMINATION OF FINE-STRUCTURE CONSTANT AND ELECTRON–MUON MASS RATIO FROM WEINBERG'S RENORMALIZATION GROUP EQUATIONS. Acharya, R.; Horvath, Z. (Dublin Inst. for Advanced Studies). Lett. Nuovo Cim.; 10: 16, 710-714(17 Aug 1974).

It is shown that the fine-structure constant and the electron-muon mass ratio can be simultaneously determined as the fixed-point solutions of Weinberg's renormalization group equation. The viewpoint is taken that the muon should not be excluded in any consideration involving the electrodynamic determination of α. (LBS)

23035 NULL ELECTROMAGNETIC FIELDS IN GENERAL RELATIVITY. Prasanna, A. R. (Inst. of Mathematical Sciences, Madras). Gen. Relativity Gravitation; 5: No. 2, 143-145(Apr 1974).

From conference on general relativity and gravitation; Banaras, India (Nov 1971).

The necessary and sufficient condition that a general Riemannian space-time $ds^2 = g_{ij}dx^i dx^j$, may represent a null electromagnetic field is $S = C$, where $S = R_{hijk} F^{hi} F^{jk}$, $C = C_{hijk} F^{hi} F^{jk}$. (auth)

23036 QUANTUM FIELD THEORIES ON THE LIGHT FRONT. Root, R. G. Urbana, IL; Univ. of Illinois (1973). 158p. University Microfilms Order No. 74-12,165.

Thesis (Ph. D.).

Several popular field theories are quantized on light fronts, that is surfaces defined by $x^+ = x^0 + x^3 =$ constant. Schwinger's quantum action principle is employed to deduce the correct canonical equal-x^+ (anti-) commutation relations. The formulations developed for free fields of spin-0, –½, –1 and –2 are equivalent to the equal-time formulations. However, in the new formulations it is easy to take the limit of vanishing mass in the massive spin-2 theory. Consistent formulations are found for self-interacting scalar fields and for scalar and Dirac fields interacting through simple couplings. The S-matrix elements are given by an x^+-ordered product rather than the usual time-ordered product. The Feynman rules for these S-matrix elements are identical to the old rules in the case of the self-interacting scalar theory, but they differ by noncovariant terms for the interacting Dirac theory. A formal proof of the equivalence of the S-matrix in the new formulation and the usual time-ordered expansion is given for renormalized interacting Dirac fields. A set of generalized Schwinger conditions for a quantum theory to be Lorentz invariant are verified in scalar and Dirac field theories; then the presence of c-number Schwinger terms in the equal-x^+ stress tensor commutators is demonstrated. This new formulation is used to find spectral sum rules and leading singularities of both the Green's function and the product of field operators near the light front. The implications for current algebra sum rules are mentioned. Reduction formulas for scalar and Dirac particles are derived. (Diss. Abstr. Int., B)

23037 GENERALIZED OPEN SHELL SCF THEORY. Caballol, R.; Gallifa, R.; Riera, J. M.; Carbo, R. (Instituto Quimico de Sarria, Barcelona). Int. J. Quant. Chem.; 8: No. 3, 373-394(May 1974).

A generalized form of the coupling operator technique in SCF theory was developed. In the formalism presented, the monoconfigurational problem may be treated as a particular case of the multiconfigurational framework. The matrix form of the operators was analyzed; in the LCAO context a structure was found which is very adequate for computational purposes. Some examples are also presented which show the usefulness of the theory, emphasising the CNDO and INDO approximations. Within the application of the method to ab initio calculations, some He and second row atoms states were studied. The He first excited singlet is also studied, the result of the analysis of such a problem being that the nonorthogonality between the singlet functions of the fundamental and of the first excited states play a primordial role in the efficiency of the method. In no case have the calculation problems, appearing in the application of the theory, been of a more difficult nature than those normally found in the application of the formalism for closed shells. (auth)

23038 EIGENSPACE MANIPULATION IN SCF THEORY: GENERAL FORMALISM. Carbo, R. (Instituto Quimico de Sarria, Barcelona). Int. J. Quant. Chem.; 8: No. 3, 423-426(May 1974).

A general formalism in order to deal with SCF eigenspace manipulation is developed. It can be shown that the initial generalized secular equation splits into a set of secular equations, each of which in turn can modify independently any predetermined subset of the SCF manifold. (auth)

23039 MATRIX MOMENT METHODS IN PERTURBATION THEORY, BOSON QUANTUM FIELD MODELS, AND ANHARMONIC OSCILLATORS. Graffi, S.; Grecchi, V. (Instituto Nazionale di Fisica Nucleare, Bologna (Italy)). Commun. Math. Phys.; 35: No. 3, 235-252(Feb 1974).

17 refs.

A matrix moment problem is considered in connection with a certain class of anharmonic oscillators as well as some field theory models, whose Rayleigh-Schroedinger perturbation expan-

sions for the ground state eigenvalue are known to diverge. The approximants related to such a problem are proven to converge to the eigenvalue, when applied to an expansion of the Brillouin–Wigner type. These approximants, whose construction involves only matrix elements occurring in the Rayleigh–Schroedinger expansion, are the approximants of a J-type matrix continued fraction, i.e., the [N-1,N] matrix Pade approximants. The explicit analytical expression of matrix continued fraction is found in the anharmonic oscillators case. (auth)

Gravitation and General Relativity

Refer also to abstract 23035.

23040 (JINR-P2-7972) MASSIVE VECTOR FIELD AND THE HORIZON SURFACE. Isaev, G. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 8p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

Within the static consideration and under the assumption of the absence of essential peculiarities everywhere besides the point r = 0, for the central-symmetrical source of the massive vector field there was shown the possibility of the following situation: the external field exists, the horizon surface is absent at any finite r. This speaks in favor of that in the process of gravity compression of the central-symmetrical body (having the zero massive vector field), the "black hole" is not produced and the field does not disappear. (auth)

23041 TWO-BODY PROBLEM IN GENERAL RELATIVITY: A NEW APPROACH. Cooperstock, F. I. (Institut Henri Poincare, Paris). Lett. Nuovo Cim.; 10: No. 13, 555-560(27 Jul 1974).

A new method is developed for computing the energy loss from gravitationally bound systems which describes the radiation during the stages when the motion is induced by the gravitational attraction between two bodies both in the presence and absence of additional nongravitational stress. The method consists in disturbing an initially static configuration of two bodies and determining the dynamic metric for a relatively short time thereafter. The retarded potentials are required to preserve causality. (LBS)

23042 MASTER EQUATION FOR COUPLED ELECTROMAGNETIC-GRAVITATIONAL PERTURBATIONS TO THE REISSNER–NORDSTROEM GEOMETRY. Lun, A. W. C. (Monash Univ., Clayton, Australia). Lett. Nuovo Cim.; 10: No. 15, 681-684(10 Aug 1974).

The results from an examination of the gauge-dependent Newman–Penrose quantities ϕ_1 and ψ_2 are presented. By making a suitable choice of gauge, two first-order quantities relating to ϕ_{1B} and ψ_{2B} satisfy a system of two coupled self-adjoint Schroedinger-type equations. (LBS)

23043 IS THE LEE CONSTANT A COSMOLOGICAL CONSTANT? Linde, A. D. (Lebedev Inst. of Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 19: No. 5, 183-184(5 Mar 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 19: No. 5, 320-322(5 Mar 1974).

It is shown that the gauge theories of elementary particles with spontaneous symmetry breaking introduce into the gravitation equations a cosmological term that varies with time. The change in this term during the evolution of the universe amounts to at least 49 orders of magnitude. (auth)

23044 FIELD EQUATIONS OF THE TREDER GRAVITATIONAL THEORY WHICH ARE DERIVABLE FROM A VARIATION PRINCIPLE. I. Kasper, U.; Liebscher, D. E. (Zentralinstitut fuer Astrophysik, Potsdam, Ger.). Ann. Phys. (Leipzig); 30: No. 2, 129-144(1973). (In German).

In the framework of Treder's gravitational theory two classes of field equations are considered which are derivable from two classes of Lagrangian densities $L^{(1)}(\omega_1, \omega_2)$, $L^{(2)}(\sigma_1, \sigma_2)$. ω_1, ω_2; σ_1, σ_2 are parameters. $L^{(2)}(\omega_1, \omega_2)$ gives field equations which are up to the post-Newtonian approximation in the sense of Nordtvedt, Thorne and Will equivalent to the field equations given by Brans and Dicke. For $\omega_2 = -1 - 2\omega_1$ field equations follow from $L^{(1)}(\omega_1, -1 - 2\omega_1)$ which are in the above mentioned sense of post-Newtonian approximation equivalent to Einstein's equations. The field equations following from $L^{(1)}(\omega_1, \omega_2)$ have a cosmological model with the well known cosmological singularities for $T \to \pm\infty$ in case that $\omega_1/(1 + 3\omega_1 + \omega_2) \equiv \gamma > 0$. For $\omega_1/(1 + 3\omega_1 + \omega_2) \leq 0$ cosmological models with no cosmological singularities exist. From $L^{(2)}(\sigma_1, \sigma_2)$ one obtains field equations which at the best give perihelion rotation 7% above Einstein's value and light deflection 7% below the corresponding Einstein's value. But in that case one can show the existence of a cosmological model without any cosmological singularity. (auth)

23045 COVARIANT SUPERPOTENTIALS IN THE GENERAL RELATIVITY THEORY. Kasper, U. (Zentralinstitut fuer Astrophysik; Potsdam, Ger.). Ann. Phys. (Leipzig); 30: No. 2, 147-154(1973). (In German).

The connection between Einstein's, v. Freud's, and Moller's views concerning the energy-momentum problem is considered. First Moller's expressions are generalized in such a way that the tetrad need not be orthornormalized. Then a covering of space-time with holonomic tetrads is marked out in the sense given by Schouten. In case that the covering of space-time with natural bases used to give the components of all quantities, is identical with the marked out covering of space-time with holonomic tetrads, one obtains from the generalized Moller's expressions the well known ones given by Einstein and v. Freud. (auth)

23046 ON THE EINSTEIN-PODOLSKY-ROSEN PARDOX. Mittelstaedt, P. (Koelin Univ. (F. R. Germany). Inst. fuer Theoretische Physik). Z. Naturforsch., A; 29: No. 4, 539-548(Apr 1974). (In German).

26 refs.

The EPR experiment is analyzed in terms of ordinary quantum mechanics and shown to be compatible with the orthodox interpretation of this theory. There is no need to refer to Bohrs solution of the EPR paradox, nor is it necessary to assume any further unusual properties of the quantum physical reality. In particular, it is shown that the EPR experiment does not contradict the fact that incommensurable properties cannot be objectivized simultaneously in a quantum mechanical system, and that the measuring process can be understood in terms of quantum theory as an interaction of the measuring apparatus and the object system. From these results it follows that there is no reason to search for modifications of the quantum theory which might be more convenient for a realistic interpretation of the EPR experiment. Furthermore, the EPR experiment cannot be used as a motivation for introducing hidden variables into the quantum theory. (auth)

23047 CHARACTERIZATION OF THE ALGEBRAIC SYMMETRY PROPERTIES OF THE RIEMANN TENSOR BY A SINGLE TENSOR EQUATION. Ebner, D. W. (Konstanz Univ., Ger.). Gen. Relativity Gravitation; 5: No. 2, 139-141(Apr 1974).

It is shown that the algebraic symmetry properties of the Riemann tensor can be expressed by a single tensor equation. (auth)

23048 DISPERSION RELATION FOR GRAVITATIONAL RADIATION IN A SCHWARZSCHILD BACKGROUND. Madore, J. (Univ., Paris). Gen. Relativity Gravitation; 5: No. 2, 169-173(Apr 1974).

A dispersion relation is derived for gravitational radiation emitted from an almost spherical object. (auth)

23049 SPINORS WITHOUT SPIN STRUCTURE. Clarke, C. J. S. (Univ., Hamburg). Gen. Relativity Gravitation; 5: No. 2, 163-167(Apr 1974).

A class of space-times without spin-strucutre is discussed. It is shown that these space-times admit a globally defined structure which is locally equivalent to a spin structure. "Generalized spinors" can be defined, locally indistinguishable from ordinary spinors, which suffice for defining particle fields. (auth)

23050 STABILITY OF A REISSNER–NORDSTROEM NAKED SINGULARITY. Denardo, G. (Univ., Trieste, Italy); Treves, A. Lett. Nuovo Cim.; 10: No. 16, 715-717(17 Aug 1974).

The solution to the Einstein equation with a regular horizon given by the Reissner-Nordstrom metric is considered. It is found that in the background field of a Reissner-Nordstrom solution with $e|M>|$, oppositely charged particles are repelled near the singularity and they cannot be captured as a consequence of a purely general relativistic effect. (LBS)

23051 SCALAR-TENSOR GRAVITATIONAL WAVES. Lu, C. K.; Liu, Y. F.; Tsou, C. L.; Kuo, H. Y. Wu Li Hsueh Pao; 23: No. 2, 95-112(Mar 1974). (In Chinese).

The complete proof of the results of previous work is presented. Furthermore it is also shown that the D-type scalar-tensor waves do not exist. (JPRS)

23052 AXIOMATIC APPROACH TO QUANTUM GRAVITY. Flato, M.; Simon, J.; Sternheimer, D. (College de France, Paris). Helv. Phys. Acta; 47: 114-118(1974).

Problems raised by an alternative quantization of gravity in an axiomatic manner are discussed and clarified. In particular, explicit arguments concerning the spin of the graviton and the stability of the geometrical light cone are presented. (auth)

23053 GRAVITATIONAL SYNCHROTRON RADIATION. Chrzanowski, P. L. College Park, MD; Univ. of Maryland (1973). 193p. University Microfilms Order No. 74-13,178.

Thesis (Ph. D.)

In an effort to explain Weber's announced detection of bursts of gravitational radiation, radiation emission by a test particle in the neighborhood of a black hole is studied. What is sought is a source of high frequency, strongly focused (gravitational synchrotron) radiation (GSR). The latitudinal focusing of GSR may be used to explain the high intensity of the reported signals, while the high frequency property enables the radiation emitted by a particle orbiting a 10^3 $M_\odot$ black hole to be in the frequency range monitored by Weber. First, scalar radiation emission by a particle moving on an unrealistic, highly energetic circular geodesic is considered. The scalar wave equation in a Kerr background is solved by separation of variables, and the scalar radiation power spectrum is found to have vanishing amplitude for the case where the central black hole is maximally rotating. The energy emitted by a particle falling off a stable orbit into a maximally rotating black hole is studied next, for a particle plunging into an $a \cong M$ Kerr black hole is argued to be the best candidate for a realistic source of GSR. However, the amplitude of plunge radiation is shown to be small, so one is left with no plausible GSR sources to explain the results of wave experiments. Finally, the case of a particle on a relativistic circular geodesic is re-examined in an effort to determine the electromagnetic and gravitational power spectra. By taking advantage of the high frequency nature of the emitted radiation, one can be able to modify the scalar radiation formulas to obtain the analogous electromagnetic and gravitational relations. The polarization of GSR is qualitatively discussed and is argued to be inconsistent with experimental results. (Diss. Abstr. Int., B)

23054 ELECTROMAGNETIC RADIATION IN WEAK GRAVITATIONAL FIELDS. Schmid, W. M. (Univ., Vienna). Acta Phys. Austr.; 39: No. 2, 172-179(1974).

The dependence of the radiant energy of a charged particle on the components of the metric tensor is examined during the free fall of the charged particle in a weak static gravitational field described by a metric tensor. The energy balance of the process is analyzed in the weak field limit. An equation is derived for the nonlocal part of the energy balance by using the linearized Green's function of the wave vector equation. The metric coefficients are defined for the calculation of the nonlocal term of the energy balance equation, and final results are obtained by adding local energy contributions. (IAA)

23055 GENERALIZATION OF EINSTEIN'S PRINCIPLE OF EQUIVALENCE SO AS TO EMBRACE THE FIELD EQUATIONS OF GRAVITATION. Klein, O. Phys. Scr.; 9: 69-72(Feb 1974).

It is shown that the apparent impossibility of deriving Einstein's field equations of gravitation in a way similar to that used by him in deriving the equations of particle motion and electromagnetism—being a direct generalization of his famous imaginary experiment of a box falling freely in a gravitational field—may be overcome by using the quantal vacuum with its fluctuations instead of the vacuum of ordinary physics with its absolute emptiness. Thus, the Dirac equation with gravitation, thereby used, appears, in contrast to the ordinary view, as the prototype of interaction theory based on general principles, one of them being a generalized principle of equivalence. (auth) (IAA)

23056 AXIALLY SYMMETRICAL SOLUTIONS OF THE SET OF EINSTEIN EQUATIONS AND OF A NONLINEAR EQUATION OF A MASSLESS SCALAR FIELD. Kolpakov, V. P.; Shikin, G. N. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 15: No. 1, 107-109 (1974). (In Russian).

The Lagrangian is selected for the system of fields. Then the system of Einstein equations and the nonlinear equation of the scalar field corresponding to this Lagrangian are presented. The statistical, axially-symmetric solutions of this system of equations are investigated. The components of the energy-momentum tensor of the scalar field are written out. An expression is given from which it is possible to determine all tensor components. It is shown that the nonlinear equation of the scalar field has the same form as in the plane case, that is, the gravitational field generated by the scalar field has no effect on the solution of the scalar field equation. The gravitational constant does not enter into the solution of the scalar field equation. (SJR)

23057 5-DIMENSIONAL SCALAR-TENSOR THEORY OF GRAVITATION. Vladimirov, Yu. S.; Antonov, V. I. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 15: No. 1, 54-64(1974). (In Russian).

Five-dimensional curved space is considered. The fifth coordinate is isolated by a method analogous to the method of chronometric invariants of Zel'manov. The five-dimensional equations of Einstein and geodesics are written in standardized invariant form. For the case that the standardized-invariant derivatives from the geometric values are equal to zero and an analog of the electromagnetic field is absent, a statistical spherical-symmetrical solution of the Einstein equations is found, and the equations of motion of specimen bodies are analyzed. (SJR)

23058 INVARIANT FITTING OF NON-HOLONOMIC MANIFOLDS IN SPACE-TIME. Polishchuk, R. F. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 15: No. 1, 109-111(1974). (In Russian).

Invariant fitting of nonholonomic isotropic manifolds existing in a Riemann manifold of events V_4 with a Lorentz signature is considered. In general a field of m-directions is called a nonholonomic manifold in a tangential manifold of a point differentiable manifold. These manifolds can be fitted to each other at the tangential manifold, if they do not have any general, nonzero directions and have complementary dimensions. The tangential manifold is decomposed into the direct sum of manifolds fitted to each other. Each nonholonomic manifold can be obtained by projecting the tangential manifold along the fitted manifold. Fittings are constructed separately for nongeodesic, geodesic and normal congruences. (SJR)

23059 DEFLECTION OF PLANE ELECTROMAGNETIC WAVES IN THE PRESENCE OF A CENTRAL GRAVITATIONAL FIELD. Shlejter, I. L. Mexico City; Universidad Nacional Autonoma de Mexico (1974). 102p. (In Spanish).

The deflection of a photon according to general relativity is calculated. The Viniegra theory which postulates that physical space is flat and the fields and their interactions are the causal agents in the movements and phenomena observed is outlined and discussed in detail. The deflection of a plane wave in the presence of a central Schwarzschild field is then calculated by the Viniegra theory. (JSR)

23060 FERMI PRINICPLE AND THEORY OF RELATIVITY. Arifov, L. Ya. (Inst. of Nuclear Physics, Tashkent). Dokl. Akad. Nauk Uzb. SSR; No. 10, 17-19(1973). (In Russian).

A system of four differential equations of first and second order in the usual derivatives and seven initial and boundary conditions in unique form is presented. These equations are equivalent to the differential equations of the isotropic geodesic system, which also hold true for the Fermi principle and relativity theory. (TTT)

23061 GRAVITATIONAL CHARGES, F-GRAVITY, AND HADRON MASSES. Sivaram, C.; Sinha, K. P. (Indian Inst. of Science, Bangalore). Pramana; 2: No. 5, 229-238(May 1974).

Two types of fundamental gravitational charges are suggested by quantization of the angular momentum (i.e. $J = n\hbar$, where n is an integer or half-integer) occurring in the uncharged and charged Kerr metrics. These charges turn out to be $e/\sqrt{\alpha}$ and e/α, where e is the unit electric charge and α, the fine strucutre constant. The use of strong (f) gravity leads to corresponding fundamental masses M_1 (f) $\sim 2 \cdot 2 \times 10^{-24}$ g and M_2 (f) $\sim 2 \cdot 3 \times 10^{-23}$ g. It is postulated that the hadrons are composed of these fundamental entities (christened ohms here). Thus, mesons are diohmic particles and baryons are triohmic particles. This has a close resemblance to the quark model, but these are gravitational charges. The charges constituting hadrons are bound together by strong (f) gravity which is superstrong compared to nuclear forces. Various hadron masses are obtained as the vibrational excitations of these composite units. The above model is capable of accounting for quantum numbers such as spin, baryon number, strangeness, and isospin. (2 tables) (auth)

REACTOR TECHNOLOGY AND REGULATION

Power Reactors, Non-Breeding, BWR-Type

23062 (EUR-5141) FEASIBILITY STUDY OF THE USE OF RADIOACTIVE FISSION PRODUCT CORRELATIONS FOR THE DETERMINATION OF BURNUP AND HEAVY ISOTOPES COMPOSITION OF BWR DODEWAARD FUEL. Brand, P.; Cricchio, A.; Koch, L. (Commission of the European Communities, Karlsruhe (F. R. Germany). European Inst. for Transuranium Elements). Jun 1974. 52p. Dep. NTIS (US Sales Only) $5.75. EUR B.Fr. 70.-.

Two fuel rods irradiated in the BWR Dodewaard power plant at 14 MWd/kg U were analyzed by non-destructive gamma spectrometric technique in the spent fuel pool of the Dodewaard plant in order to determine concentration ratios of selected fission products. Subsequent destructive examination of seven pellet-size fuel samples of the two rods were performed at the laboratories of the European Institute for Transuranium Elements by gamma analysis and mass spectrometric isotope dilution analyses to determine the burnup (monitors: Nd-148 and Cs-137), heavy nuclide and radioactive fission product concentrations. The consistency of destructive results was checked by previously established correlations of fission product ratios versus burnup and heavy isotopes. It can be concluded that the ratio Cs-134/137 can be useful to determine burnup and heavy isotope composition of spent fuel. 10 references. (auth)

23063 (KFK-EXT-6/73-4) COMPARISON OF EXPERIMENTALLY DETERMINED CENTRAL TEMPERATURE OF BWR FUEL RODS WITH VALUES CALCULATED BY MEANS OF SATURN-L. Elbel, H.; Goebel, D. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Material- und Festkoerperforschung). Sep 1973. 35p. (In German). Dep. NTIS (US Sales Only) $4.75.

Using the version SATURN-L of the computer code SATURN-1 calculations have been performed to analyze the thermal behavior of fuel rods of boiling water reactors. Central temperatures determined for different linear rod powers have been compared with results of measurements carried out at Halden and Juelich. The calculations are in good agreement with the experiments. This shows that the thermal behavior of BWR fuel rods is described in a satisfactory way by means of the thermal models applied in SATURN-L. Thus, this code can serve as a useful tool for the thermal design of these fuel rods. (auth)

23064 (KFKI-74-32) BURN-1, A COMPUTER CODE FOR CRITICAL HEAT FLUX CALCULATIONS IN TUBES AND ROD BUNDLES. Gyenes, G.; Szabados, L. (Kozponti Fizikai Kutato Intezet, Budapest (Hungary)). 1974. 20p. Dep. NTIS (US Sales Only) $4.00.

A computer code is described for dealing with critical heat flux calculation in tubes and rod bundles. The computer code has been developed for water cooled reactors. Because of its modular structure it is easy to insert new correlations into the program. 9 references. (auth)

23065 (RT-ING-(74)5) SAFETY MARGINS AGAINST BURNOUT IN BWR'S. Marinelli, V.; Testa, G. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). Feb 1974. 21p. (CONF-731063-3). Dep. NTIS (US Sales Only) $4.25.

From meeting of specialists on the safety of fuel elements for water reactors; Saclay, France (22 Oct 1973).

The BWR core safety margins against burnout are discussed and a new concept of critical power ratio (CPR) is suggested in substitution of the critical heat flux ratio (CHFR) as figure of merit of fuel elements safety. 10 references. (auth)

23066 COMPUTERIZED AUTOMATED ULTRASONIC EXAMINATION OF LIGHT-WATER REACTOR SYSTEMS. Lewis, R. C. (Atomics International, Canoga Park, CA). Trans. Amer. Nucl. Soc., Suppl.; 19: No. 2, 16(1974).

From conference on nondestructive testing in the nuclear power industry; Columbus, OH (23 Sep 1974).

23067 PROBLEMS OF CHOICE BETWEEN ENRICHED URANIUM AND NATURAL URANIUM FUELLED REACTORS. Lombardi, C. (CISE, Milan). Energ. Nucl. (Milan); 21: No. 7, 416-420(Jul 1974). (In Italian).

Problems are discussed which arise in the choice between light water and heavy water reactors, mainly in the light of a suitable strategy of nuclear fuel supplies. Owing to the foreseeable mid-term shortage of enriched uranium, the conclusion is reached that heavy water reactors—after further confirmations of their reliability and safety—could represent a valid alternative to light water reactors. (auth)

23068 970-MVA GENERATOR TRANSFORMER FOR THE BRUNSBUETTEL NUCLEAR POWER PLANT. Feyertag, H. (Transformatoren Union A.G., Nuernberg (F.R. Germany)). Energ. Tech.; 26: No. 4, 95-98(Apr 1974). (In German).

6 figs.; 3 tabs.; 6 refs.

The Kraftwerk Brunsbuettel Ltd., a subsidiary of HEW and NWK, has bought a generator transformer with a rated capacity of 970 MVA from Transformatoren Union. The energy generated by this power plant is directly fed into the 380-kV grid. The transformer has a non-adjustable transformation ratio, the unit voltage is 27 kV. It has been designed so as to meet the requirements concerning overexcitation, overvoltage, flood protection and interchangeability. The transformer will be installed in a separate house to keep the operating noise within the set limits. Cooling is done via an oil-water cooling cycle consisting of four units, one unit being the standby system. (GE)

23069 WHY CEGB BACKS LIGHT WATER REACTORS. Arch. Energiewirtsch.; 28: No. 8, 406-407(Apr 1974). (In German).

Also published in English in Electr. Times.

A comparison of AGR-type reactors with light water reactors indicated that the design of the light water reactors offers better solutions to the problems associated with both reactor types. This has led CEGB to decide in favour of LWRs to meet future energy demands. (GE)

23070 OFF-GAS TREATMENT SYSTEM FOR BOILING WATER REACTORS. Hendrickson, T. A.; Patti, F. J. Power Eng.; 78: No. 8, 4851(Aug 1974).

Systems for processing noble gases in the condenser off-gas stream of BWRs are discussed. The systems employ charcoal adsorption at ambient, low, or cryogenic temperatures, cryogenic distillation, or fluorocarbon absorption. The performance of the systems is compared. (DG)

23071 STRUCTURAL FEATURES OF FUEL ELEMENTS FOR BOILING WATER POWER REACTORS. Kalashnikov, V. V.; Kulikova, K. V.; Yamnikov, V. S. At. Tekh. Rubezhom; No. 12, 3-11(Dec 1973). (In Russian).

Special structural features of fuel elements for boiling reactors and conditions of operation are described. Typical structural features of heat-releasing assemblies and methods for spacing the fuel elements are discussed. The chief type of fuel in these elements is uranium dioxide. Results obtained in the use of the fuel elements and reasons for removing them from the stream are discussed. In conclusion, the structural peculiarities of fuel elements for nuclear steam superheaters are described. (INIS)

Power Reactors, Non-Breeding, PWR-Type

Refer also to abstracts 23064, 23066, 23067, 23069, 23168, 23170–23175, 23225, and 23250–23254.

23072 (AED-Conf-74-052-001) ON THE IMPORTANCE OF REACTOR CORE INSTRUMENTATION FOR SAFE AND ECONOMIC REACTOR OPERATION. Sommer. (Kernkraftwerk Obrigheim G.m.b.H., Obrigheim/Mosbach (F. R. Germany)). Jan 1974. 24p. (In German). INIS.

From colloquium on nuclear energy and technology, Institut fuer Kernenergietechnik, Stuttgart Univ., winter term 1973/74; Stuttgart, F. R. Germany (1 Feb 1974).

24 figs.

The core instrumentation of the Obrigheim reactor, mainly in-core measurements using activated Mn spheres, which should indicate a possible power increase as soon as possible is discussed. The experimental results obtained with this measuring method show that although the spatial resolution is very good, the time resolution is rather poor. (GE)

23073 (KFK-1899, pp 153-161) SPACE AND EXHAUST GAS MONITORING AT THE OBRIGHEIM NUCLEAR POWER PLANT. Stephan, W. (Kernkraftwerk Obrigheim GmbH, Obrigheim, Ger.). Mar 1974. (In German).

The special aspects of air and off-gases monitoring at a nuclear power plant are explained. Possible sources of airborne radioactivity and radioisotopes which occur are named. In order to understand the selection of the measuring point, a short de-

scription is given of the components of the system which are known to be radioactive and of the off-gas system. The characteristic measuring rates and measuring methods for airborne activity as well as experimental results are discussed in detail. (tr-auth)

23074 (WCAP-7959) EFFECT OF AXIAL SPACING ON INTERCHANNEL THERMAL MIXING WITH THE R MIXING VANE GRID. Cadek, F. F.; Motley, F. E.; Dominicis, D. P. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). Jan 1973. 54p.

Three test series conducted at Columbia University under the direction of Westinghouse to determine the thermal diffusion coefficient (TDC) for a new type of mixing vane grid (R) are described. The three experiments used axial grid spacings of 13, 26, and 32 in. in a 6 ft long, 6 × 6 rod bundle. Tests were conducted over a range of thermal-hydraulic conditions similar to those found in a PWR core. The value of thermal diffusion coefficient (TDC) was determined by matching the experimental exit enthalpy distribution to that predicted by the THINC computer code. TDC was found to be a function of grid spacing and independent of: Reynolds No. mass velocity, pressure, and quality. A value of 0.038 is recommended as a conservative design value of TDC for 26″ and 32″ spacing. 5 references. (auth)

23075 NONDESTRUCTIVE TESTING OF SAXTON FUEL RODS FOR PBF. Francis, W. C.; Gibson, G. W.; Schmunk, R. E. (Aerojet Nuclear Co., Idaho Falls, ID). Trans. Amer. Nucl. Soc., Suppl.; 19: No. 2, 9(1974).

From conference on nondestructive testing in the nuclear power industry; Columbus, OH (23 Sep 1974).

23076 RESEARCH AND DEVELOPMENT OF STEAM GENERATORS FOR PRESSURIZED WATER REACTORS. Faldini, F. (Breda Termomeccanica, Milan); Hasid, A. Energ. Nucl. (Milan); 21: No. 6, 353-365(Jun 1974). (In Italian).

A steam generator research program aimed at improving knowledge of materials and welding techniques, stress analysis, component-hydraulic characteristics, thermal-hydraulic instability, tube bundle vibration, and separators is described, and the main research lines which have been undertaken and the information so far obtained is reported. (auth)

Power Reactors, Non-Breeding, Graphite Moderated

Refer also to abstracts 23069, 23226, and 23242.

23077 (CEA-N-1693) DETERMINATION OF THE MULTIPLICATION FACTOR OF AN HTR LATTICE, IN THE CRITICAL ASSEMBLY MARIUS III, BY A PCTR METHOD. Laponche, B.; Gambier, G.; Estiot, J. C.; de Lapparent, D.; Garnaud, P.; Luffin, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physique des Reacteurs et de Mathematiques Appliquees). Feb 1974. 101p. (In French). Dep. NTIS (US Sales Only) $8.25.

An experiment performed in the critical assembly MARIUS at Cadarache (1972) on an HTR lattice is presented. The method used is that of the PCTR experiments and is based on the null reactivity effect of the removal of the central cell in the reactor. The cell is hexagonal (90 mm pitch), with annular particulated fuel. The loose particles' kernel is 1% enriched UO_2. The experimental technique is based on the poisoning of the lattice by various quantities of an absorbing material (aluminum, copper, and vanadium were used). The null reactivity or PCTR condition is reached when the poison mass is such that there is no reactivity variation when one removes the central cell of the poisoned zone. The creation of this central cavity has been considerably improved by the use of an oscillation technique. The corrections to be applied to the rough experimental results (poison mass in the null reactivity situation) have been thoroughly determined: air in the cavity instead of void, axial heterogeneities of loading, delayed neutrons, non-fundamental spectrum at the center of the reactor. The method of analysis is based on the calculation of the PCTR condition. The use of the adjoint function of the neutron flux leads to a relation between the various terms of the neutron balance into the substituted (or cavity) volume: $k^{\sim +} = 1$. In the case of a homogeneous lattice, this condition is $k_\infty = 1$. Comparison between calculation and experiment is then by the calculation of $k^{\sim +}$ by the multigroup (99 energy groups), multiregion code APOLLO which uses the collision probabilities formalism. For the measured lattice, the discrepancy between the k_∞ of the lattice (deduced from $k^{\sim +}$ and 1 is of the order of 1000 pcm (10^{-2}), with a 300 pcm accuracy on the measurement itself. (FR)

23078 (GA-A-12870) METHODS OF STRESS ANALYSIS IN USE AT GENERAL ATOMIC FOR CORE DESIGN. Smith, P. D. (General Atomic for Core Design. Smith, P. D. (General Atomic Co., San Diego, Calif. (USA)). 1 May 1974. 148p.

The methods currently in use at General Atomic for the stress analysis of graphite core structures in an HTGR reactor environment are discussed. The particular components to which these methods are applicable include the fuel blocks and the replaceable reflector blocks. As a preliminary background, the operating environment in an HTGR is discussed. In essence, the environment is a combination of high temperature and fast neutron flux which varies with three spatial coordinates and time. The behavior of the graphite material in this environment is discussed. A linear viscoelastic rheological model is presented which has been shown to describe the material response. The material model includes the effects of elastic strains, thermal strains, stress-free irradiation strains, steady creep, and recoverable transient creep. Next, structural idealizations based on thermal and structural symmetry considerations are discussed. These permit the analysis of the problems by one- and two-dimensional methods. The main body of the report contains detailed descriptions of the theory and the solution methods used in four different stress analysis codes. These are: 1. TREVER/STRESS--a core survey code that uses viscoelastic beam theory to locate critical areas; 2. GBEAM--a viscoelastic beam theory code that employs very general geometrical, environmental, and boundary condition descriptions; 3. SAFE GRAFIT--a two-dimensional, linear viscoelastic, finite element code capable of axisymmetric, plane strain, and generalized plane strain analysis of graphite structures; 4. TEPC--a two-dimensional finite element code capable of Thermal-Elastic-Plastic-Creep analysis of a variety of structures. (auth)

23079 (GA-A-13010) GENERAL ATOMIC QUALITY ASSURANCE PROGRAM. (General Atomic Co., San Diego, Calif. (USA)). May 1974. 62p. (GA-LTR-11).

Information on a quality assurance program for HTGR reactors is presented concerning quality assurance during design and construction; organization; quality assurance program; design control; procurement document control; instructions, procedures, and drawings; document control; control of purchased material, equipment, and services; identification and control of materials, parts and components; control of special processes; inspection; test control; control of measuring and test equipment; handling, shipping, and storage; inspection and test status; non-conforming materials, parts or components; corrective action; quality assurance records; and audits. (DCC)

23080 (INIS-mf-1360) IRRADIATION TRANSFORMATION OF NUCLEAR FUEL IN HTGR TYPE REACTORS. de Oliveira Filho, J. M. (Sao Paulo Univ. (Brazil). Escola Politecnica). 1972. 161p. (In Portuguese). INIS.

Thesis.

A program for the calculation of the irradiation transformation of nuclear fuel in HTGR type reactors is presented. The program is based on a nuclear point model and on the principal characteristics of the fuel cycle. The nuclear point model disregards the effects of relative position of the nuclear fuel in the reactor, as well as the spatial variation of the neutron flux. It lends itself, nevertheless, to the type of analysis for which it is proposed, producing satisfactory results. The reactor is assumed to operate in a high enrichment cycle. The principal parameters of the cycle are analyzed theoretically and practically. (auth)

23081 (JUL-1037-RX) TESTING OF THE START-UP INSTRUMENTATION FOR THE POWER AND PROCESS HEAT REACTOR PR 500. Report on the Experiment MV 18 in the FRJ-1. Schmidt, K. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Zentralinstitut fuer Reaktorexperimente). Dec 1973. 30p. (In German). INIS.

10 figs.; 7 refs. With abstract.

Several methods of measuring the neutron flux density are described. The criteria to be considered in the selection of appropriate detectors for neutron flux density measurements are discussed. The determination of operating mode (pulse, d.c. and a.c. methods) and the testing of detectors under simulated operating conditions are described. (GE)

23082 IMPROVEMENTS IN OR RELATING TO FUEL FOR NUCLEAR REACTORS. Prince, K.; Shannan, J. V. (to United Kingdom Atomic Energy Authority). British Patent 1,347,487. 20 Feb 1974. 2p.

Reference is made to methods of making fuel pins for High Temperature Reactors, comprising compacts of coated particles within a cylindrical graphite sheath. The method described involves forming an assembly of fuel compacts and sheath in an unfinished state and then heat treating the assembly to bond the sheath and compacts together. The sheath is formed from graphite powder

and a resin binder, and while in a plastic state it is pressed under isostatic pressure. Longitudinal finning may be provided on the outer surface of the sheath. (UK)

23083 SUBMERGED GAS CIRCULATOR MOTORS FOR HINKLEY B AND HUNTERSTON B AGR POWER STATIONS. Schwarz, K. K LSE Eng. Bull.; 13: No. 1, 6-12(1974).

Four of the five AGR nuclear stations under construction are designed with submerged gas circulator motors. In Hinkley Point B and Hunterston B, which are discussed, horizontal machines are used. Brief reference is made to design principles, prototype work, and performance requirements. In more detail are discussed the assembly of the machines and the testing procedure carried out, including some experiences during testing. Ancillary equipment, which includes the circulator output control system and the pumping system, is briefly described. (UK)

23084 HTGR NUCLEAR POWER STATIONS TODAY AND TOMORROW. Melese-D'Hospital, G. (Gulf General Atomic, Inc., San Diego, CA). Rev. Fr. Energ.; 25: No. 261, 369-380 (Mar 1974). (In French).

Following the successful operation of three experimental reactors and the building of a prototype station, the HTGR system has now become available on the commercial market. The first steps, the evolution, and the resultant HTGR commercial stations are recalled, and remarks are made concerning the future applications of HTGR in various fields. (FR)

23085 STEAM TURBINE FAILURE AT HINKLEY POINT A. Kalderon, D. Proc. Inst. Mech. Eng. (London); 186: No. 31/72, 341-377(1972).

A catastrophic failure of a turbine generator unit at a first generation British Magnox Nuclear Power Station is described. The failure, which completely wrecked the whole unit, occurred in September 1969, during a routine overspeed test. Broad descriptions of connected avenues of approach to the failure analysis are given. Fracture mechanics allowed the firm conclusion to be drawn that the cause of the failure was small cracks, about $^1/_{16}$ in. deep, in the keyways of the low-pressure turbine discs. Although the cracking was to a certain extent stress dependent, it was more dependent on the location within the unit. This evidence pointed in a direction whereby it was established that the cracks had been initiated by stress corrosion rather than by conventional fatigue. The disc material and stress levels were all within normally accepted practice but some temper embrittlement of the 3 Cr–Mo steel had resulted in areas of low fracture toughness. Fracture mechanics showed that the small cracks in the apex of the semicircular keyways were sufficient to cause brittle fracture at about design ratings. Cracks outside of the keyway, or keyways without cracks, were shown to be unimportant. Brittle fracture of one disc triggered others and sparked off a chain reaction which broke the main shaft in five places, completely destroying the unit. (UK)

Power Reactors, Non-Breeding, Otherwise Moderated

Refer also to abstracts 21872, 23067, 23155, 23222, 23224, 23228, 23232, 23235, 23236, and 23261.

23086 (AECL-4441) SUMMARY REPORT ON THE DESIGN OF A PROTOTYPICAL 500 MWe CANDU-OCR POWER STATION. (Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment). Jun 1974. 72p. Dep. NTIS (US Sales Only) $6.75. AECL $2.00.

In March 1971, the Board of Directors of Atomic Energy of Canada Limited authorized the study of a 500 MW(e), natural uranium carbide fuelled, organic-cooled, nuclear power station. In June 1971, a study team, consisting of Whiteshell Nuclear Research Establishment and Power Projects staff, was established to develop the design concept for a prototype station and to assess its commercial feasibility at this time. The results of that study are summarized. (auth)

23087 (AECL-4661) TEMPERATURE COEFFICIENTS OF REACTIVITY FOR NATURAL URANIUM FUEL AND URANIUM-PLUS-PLUTONIUM FUEL IN ORGANIC COOLANT AND HEAVY WATER MODERATOR. Lyon, R. B. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Apr 1974. 25p. Dep. NTIS (US Sales Only) $4.25. AECL $1.00.

Isothermal channel temperature coefficients of reactivity for natural uranium and uranium-plus-plutonium fuels cooled by organic liquid and moderated by heavy water are calculated and compared with experiments. Factors affecting the temperature coefficients are isolated and discussed. The importance of the choice of the thermal scattering law for the organic coolant is assessed. Scattering laws tested were those for hydrogen in benzene, diphenyl, and polyethylene. (auth)

23088 (JUL-1059-RG) OTTO-PEBBLE BED REACTOR IN THORIUM FUEL CYCLE. Teuchert, E.; Maly, V.; Haas, K. A. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Reaktorentwicklung). Apr 1974. 58p. (In German). Dep. NTIS (US Sales Only) $6.00.

Research is presented for the OTTO-pebble bed reactor fuelled with high enriched uranium and thorium. A variational study yields the influence of parameters of design and fuel cycle. There are many differences compared to the low enriched fuel cycle, and they are shown to be mainly due to the presence of protactinium and the absence of bred plutonium isotopes. An optimized reference design has been derived and discussed in detail. It is suggested to be a basis for an assessment of this system and for further development of process heat application. 8 references. (auth)

23089 (JUL-1070-RG) OTTO-PEBBLE BED REACTOR FOR A 1000 MWe HELIUM TURBINE PLANT. Teuchert, E.; Ballensiefen, G.; Haas, K. A.; Maly, V.; Mielken, G.; Petersen, K.; Ruetten, H. J.; Uhlenbusch, L.; Will, M.; Wolf, L. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Reaktorentwicklung). May 1974. 72p. (In German). Dep. NTIS (US Sales Only) $6.75.

A 2700 MW(t) OTTO-pebble bed reactor for a direct cycle helium turbine plant is presented resulting from a technical and economical optimization. The calculational research presents the nuclear properties, thermal hydraulics and cost evaluation. Some more detailed analysis on reactor control fission product release and reflector are performed as far as required for assessing this concept. A discussion of alternatives in the design of fuel elements and reflector illustrates the flexibility inherent to this type of reactor. 22 references. (auth)

23090 TAIWAN RESEARCH REACTOR PROJECT. McFarland, A. R.; Ohberg, J. W.; Voisard, J. P. pp Paper No. CNA'73-402 of Proceedings of the Thirteenth Annual International Conference of the Canadian Nuclear Association. Toronto; Canadian Nuclear Association (1973).

From 13th annual international conference of the Canadian Nuclear Association; Toronto, Ontario (17 Jun 1973).

The construction of the Taiwan Research Reactor by AECL, Canatom Limited, and the Foundation Company of Canada is described. Details of the work on the reactor building are given, as well as leakage tests performed, installation of the calandria and shielding, installations of control instrumentation, electrical and ventilation equipment, and process systems. (CA)

23091 RAJASTHAN PROGRESS AND OPERATION AND PLANS FOR NULEAR POWER IN INDIA. Kati, S. L. (Dept. of Atomic Energy, Bombay). pp Paper No. CNA'73-203 of Proceedings of the Thirteenth Annual International Conference of the Canadian Nuclear Association. Toronto; Canadian Nuclear Association (1973).

From 13th annual international conference of the Canadian Nuclear Association; Toronto, Ontario (17 Jun 1973).

The construction, commissioning, and early operation of Unit-1 of the Rajasthan Atomic Power Project (RAPP-1) as a joint effort between the Department of Atomic Energy of India (DEA) and various Canadian nuclear and engineering corporations is reviewed. Commissioning of the reactor is discussed with reference to the containment, moderator system, PHT system, fuel loading and cobalt absorber assemblies. India's plans for future nuclear developments, the Madras Atomic Power Project (MAPP) and the Narora Atomic Power Project (NAPP), call for scaled-up versions of the Candu PHW-type reactor with intentions of eventually constructing reactors in the 400-500 MW(e) range based upon the Pickering and Bruce designs. (CA)

23092 FUGEN PROJECT. Shima, S.; Sawai, S. (Power Projects and Nuclear Fuel Development Corp., Tokyo). pp Paper No. CNA'73-204 of Proceedings of the Thirteenth Annual International Conference of the Canadian Nuclear Association. Toronto; Canadian Nuclear Association (1973).

From 13th annual international conference of the Canadian Nuclear Association; Toronto, Ontario (17 Jun 1973).

FUGEN, a prototype of a heavy water moderated boiling light water cooled reactor (165 MW(e) similar in design to the Gentilly reactor, is now under construction in Japan and scheduled to achieve criticality in 1975. A general description is given of the reactor core characteristics, safety systems, pressure tube design, refueling machine and fuel assemblies. Construction schedules, reactivity disturbance responses and configuration diagrams are included. (CA)

23093 PHYSICS AND CONTROL OF PU-FUELED HEAVY WATER REACTOR FUGEN. Haga, T.; Kato, H. (Power

Reactor and Nuclear Fuel Development Corp., Tokyo). pp Paper No. CNA'73-TS-3 of Proceedings of the Thirteenth Annual International Conference of the Canadian Nuclear Association. Toronto; Canadian Nuclear Association (1973).

From 13th annual international conference of the Canadian Nuclear Association; Toronto, Ontario (17 Jun 1973).

The core physics of Pu-fuel FUGEN reactor is discussed with emphasis on the reactivity coefficients. Of the isotopes of Pu fuel, Pu-239 and Pu-241 are found to reduce coolant void reactivity, and Pu-240 to reduce fuel temperature coefficient. From the physics aspect of the core, reactor control and refueling problems are briefly discussed and evaluations are performed. (auth)

23094 MEASUREMENT OF THE SPATIAL DYNAMICS OF NUCLEAR SYSTEMS: APPLICATION TO GENTILLY-1. Serdula, K. J. (Atomic Energy of Canada Ltd., Chalk River, Ont.); Kendall J. D.; Cloutier, P. M. pp Paper No. CNA'73-TS-5 of Proceedings of the Thirteenth Annual International Conference of the Canadian Nuclear Association. Toronto; Canadian Nuclear Association (1973).

From 13th annual international conference of the Canadian Nuclear Association; Toronto, Ontario (17 Jun 1973).

Gentilly-1 is a prototype nuclear power station cooled by boiling light water and moderated by heavy water. The problem of flux tilting has been attacked by constructing a computer model of variations in neutron flux, using the same dual computer system that is used for reactor control. The regular control neutron absorbers were used to create perturbations in reactivity, and the response of the neutron flux was monitored by the available instruments. In this way, transfer functions were calculated, and control equations obtained. Actual measurements on reactors such as those obtained at Gentilly-1 will be necessary to predict the behaviour of larger power reactors. (CA)

23095 FUEL FOR CANDU PRESSURIZED HEAVY WATER REACTORS. Page, R. D. (Atomic Energy of Canada Ltd., Montreal). Nucl. Eng. Int.; 19: No. 217, 496-497 (Jun 1974).

The UO_2-zircaloy sheathed fuel for Candu reactors was designed to be reliable and inexpensive and is therefore simple. A very brief outline is given of its development. Design and operating conditions for the various Candu reactor fuels are tabulated. Special fabrication techniques are mentioned. Advantages of the Candu system, which are discussed, include low fuel supply costs, excellent in-service performance of the fuel, and ability to adapt to different coolant cycles and conditions. (UK)

23096 GENTILLY-2: 600 MW OF NUCLEAR POWER. Mod. Power Eng.; 68: No. 5, 66-67 (May 1974).

Gentilly-2 will be similar to Pickering Nuclear Generating Station but will consist initially on only one 600 MW(e) reactor, with provision for adding a second. It will use the CANDU-PHW system, with natural uranium fuel and pressurized heavy-water coolant. Dousing water will be used in the emergency system, instead of a vacuum building as at Pickering and Bruce. There will be four boilers arranged in two independent banks. Construction started in November 1973, and the reactor is planned to deliver power on 1 January 1979. A cut-away drawing of the reactor building is included. Under a separate contract, AECL will build a 800 ton/year heavy-water plant near Gentilly-1 and Gentilly-2 stations, so that it can use steam from them. (CA)

Power Reactors, Breeding

Refer also to abstracts 20928, 20990, 20999, 21000, 21007, 23145, 23146, 23154, and 23167.

23097 (AED-Conf-74-066-003) FUEL IMPACT ON THE BEHAVIOUR OF SNR-300 FUEL PINS AT HIGH BURNUP. Thuemmler, F. 1974. 7p. (In German). INIS.

From status report of the Projekt Schneller Brueter; Karlsruhe, F. R. Germany (26 Mar 1974).

9 figs.

The changes in the nuclear fuel at high burnup and their impact on the cladding material are studied. The redistribution of voids in the fuel under irradiation is discussed, as well as deformations of cladding tube due to swelling and creep. The results of the studies show that Cs, I and Te are the most dangerous fission products with regard to fuel-cladding interactions. (GE)

23098 (AED-Conf-74-066-009) STATE OF THE INDUSTRIAL WORK FOR THE CONSTRUCTION OF THE SNR-300. Traube, K. 1974. 18p. (In German). INIS.

From status report of the Projekt Schneller Brueter; Karlsruhe, F. R. Germany (26 Mar 1974).

8 figs.

The present state of the construction work, special details of the licensing procedure as well as some technical problems encountered since the beginning of construction are summarized. Some data concerning the breeding rate of the reactor and information about the fast breeder development in other countries are also given. (GE)

23099 (ANL-RDP-28) REACTOR DEVELOPMENT PROGRAM PROGRESS REPORT, MAY 1974. (Argonne National Lab., Ill. (USA)). 28 Jun 1974. Contract W-31-109-Eng-38. 145p. AT.

Progress in LMFBR and GCFR development studies is reported under the following readings: EBR-2; hot fuel examination facility; fuels and materials development; reactor physics; reactor safety; other fast breeder reactors; and advanced fuels program. (JWR)

23100 (CONF-740609-4) CLINCH RIVER BREEDER REACTOR: A COMBINED POWER AND FUEL SOURCE. Jacobi, W. M.; Tang, Y. S. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). 1974. 19p. Dep. NTIS $4.00.

From 77th national meeting on the American Institute of Chemical Engineers; Pittsburgh, Pennsylvania, USA (2 Jun 1974).

The features of LMFBR type reactors, the design status of the Clinch River Breeder Reactor, and the projected future improvements for commercial fast breeders are presented. 7 references. (auth)

23101 (COO-2250-9) MIT LMFBR BLANKET RESEARCH PROJECT. Quarterly Progress Report, April 1, 1974-June 30, 1974. Driscoll, M. J. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Nuclear Engineering). 1974. Contract AT(11-1)-2250. 17p. Dep. NTIS $4.00.

Progress in the experimental and theoretical investigation of LMFBR breeding blanket design parameters is reported. Data are presented on gamma heating in stainless steel, ^{238}U self-shielding effects, effect of core size on breeding ratio, and nickel reflector performance. (DG)

23102 (FRNC-TH-497) OPTIMIZATION OF BURST SLUG LOCALIZATION PROCESSES AND THE CORRESPONDING DISCHARGING IN NUCLEAR REACTORS. Chauvin, A. (Aix-Marseille-1 Univ., 13 - Marseille (France)). 1973. 181p. (In French). Dep. NTIS (US Sales Only) $12.25.

Thesis.

The attribution of bursting probabilities is discussed for fissile assemblies in reactor cores. The following criteria are used: stresses and phenomena induced in the fuel and cladding as a function of specific burn up, changes in the temperature of the sodium at the assembly outputs, detection of gas tracers introduced into the pins, detection of delayed neutrons, and determination of the age of pins from measurements of the characteristic ratio of two xenon isotopes. In this way, an overall curve can be established for the burst slug probabilities in the assembly. Once the faulty element has been located, its assembly must be extracted from the reactor. The optimization of the cost of extracting a burst slug from a fast neutron reactor is also discussed. (FR)

23103 (HEDL-TME-74-19) MODELING OF THE POST-IRRADIATION FUEL-CLADDING GAP IN MIXED-OXIDE FUELS. Dutt, D. S.; Baker, R. B.; Chastain, S. A. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Apr 1974. Contract AT(45-1)-2170. 19p. AT.

A correlation of the post-irradiation fuel-cladding gap was developed for mixed-oxide fuel pins. The correlation was developed using measurements from 76 metalographic cross sections taken from HEDL fuel pins irradiated in EBR-II. The correlation for the change in gap size is given. (5 references) (auth)

23104 (RT/ING-(74)3) VERIFICATION OF THE PEC CONTAINMENT VESSEL FOR SOME OPERATING CONDITIONS BY USE OF THE FINITE ELEMENT CODE SAFE-SHELL.B. Cesari, F.; Labanti, L.; Palmieri, I. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). Jan 1974. 160p. (In Italian). Dep. NTIS (US Sales Only). $11.25.

The metal vapor containment building of PEC reactor has been verified taking into account all mechanical and thermal loads with axisymmetric distribution along any parallel. Neither containment penetrations nor vibratory motion loads are considered. The stress analysis is performed by applying the SAFE-SHELL.B, new version written for IBM-360 computer. The loading conditions imposed to the containment vessel are discussed in detail to clarify general criteria and their implication in this design, because this calculation is a test and an example to demonstrate the kind and validity of results obtainable by using Class 1 concept instead of MC Class criteria of the same Sct. III BPY ASME Code. The output of the computer code and the exact solution of membrane shell theory for torispherical head are compared. (23 references) (auth)

23105 (RT/ING-(74)8) BURN-OUT CORRELATION FOR ON ONCE-THROUGH L.M.F.B.R. STEAM GENERATORS. Campo-

lunghi, F.; Cumo, M.; Ferrari, G.; Vaccaro, G. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). Feb 1974. 15p. Dep. NTIS (US Sales Only) $4.00.

The burnout quality in long, straight and vertical, once-through steam generators may differ greatly from the values predicted using well known burnout correlations experimentally obtained for the reactor core (shorter lengths, higher heat fluxes). Results of experimentation are presented. (auth)

23106 (UJV-3279-R) BASIC PHYSICAL CHARACTERISTICS OF THE ACTIVE ZONE OF FAST POWER REACTORS. Tinka, I.; Tinkova, E.; Chermak, I. (Ustav Jaderneho Vyzkumu, Rez (Czechoslovakia)). Apr 1974. 44p. (In Russian). Dep. NTIS (US Sales Only) $5.25.

The complete physical calculation of a variant of the BN-350-type fast reactor in multigroup diffusion approximation has been carried out. The main results are presented for criticality and neutron flux, heat-release distribution, reactivity effects etc. calculations. (9 references) (auth)

23107 (WARD-OX-3045-12) OXIDE FUEL ELEMENT DEVELOPMENT. Quarterly Progress Report for Period Ending March 31, 1974. Boltax, A ; Saling, J. H. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). Jul 1974. Contract AT(11-1)-3045. 143p. AT.

Progress in the development and testing of stainless steel clad mixed oxide fuel pins for LMFBR's is reported. Included are discussions and data on fuel pin irradiation testing in EBR-2, LMFBR grid-type subassembly design and evaluation, and analytical methods for evaluation of fuel and cladding irradiation behavior. (DG)

23108 (WB-KE-2024) DEVELOPMENT OF A GAS COOLED BREEDER REACTOR: A CONTRIBUTION TO THE EUROPEAN PROJECT "EUROPEAN ASSOCIATION FOR GAS COOLED BREEDER REACTORS". Hegar, N. (Waagner-Biro A. G., Vienna (Austria)). Mar 1972. 23p. (In German). INIS.

The results of a gas cooled breeder reactor development project obtained by the end of 1971 by the EUROPEAN ASSOCIATION FOR GAS COOLED BREEDER REACTORS are summarized. The state of the project and the prospects of the GCFBR are analyzed from technical and economic points of view. Two designs of a GCFBR have been studied which differ only in the type of fuel elements used. One reactor type uses metal-clad pins as fuel elements, the other coated particles. In both cases helium is used as the coolant and prestressed concrete for the pressure vessels. Technical and economic aspects of both reactor types have been studied assuming a net output of 1000 MW(e). A comparison of both reactor types with a LMFBR and a HTR is made and the conclusion is drawn that the GCFBR has good prospects for the future. (INIS)

23109 TEMPERATURE FIELDS IN LIQUID-METAL-COOLED ROD ASSEMBLIES. Nijsing, R.; Eifler, W. (CCR-EURATOM, Ispra, Italy). Progr. Heat Mass Transfer; 7: 115-149(1973).

From international seminar on liquid-metal heat transfer; Trogir, Yugoslavia (6 Sep 1971).

A survey is given of heat transfer in rod assemblies cooled by axial, turbulent flow of liquid metal. The discussion is restricted to steady-state conditions, uniform heat generation in the rods, and fully developed flow and heat transfer. Theoretical considerations center on turbulent transport characteristics and on methodology of computation. An outline of recent work in this area by the authors is included. (auth)

23110 COMPARISON OF ANALYTIC AND LUMPED-PARAMETER SOLUTIONS FOR STEADY-STATE HEAT TRANSFER IN FUEL-ROD ASSEMBLIES. Ginsberg, T.; France, D. M. (Argonne National Lab., IL). Progr. Heat Mass Transfer; 7: 167-178(1973).

From international seminar on liquid-metal heat transfer; Trogir, Yugoslavia (6 Sep 1971).

A comparative study of analytic and lumped-parameter methods applied to steady-state heat transfer in nuclear fuel-rod assemblies is presented. The two methods were applied to an idealized, finite fuel-rod system which displays essential features of real fuel assemblies. Results of this investigation show that excellent agreement between the two methods can be obtained if theoretically predicted length scales are used as "effective mixing lengths" for conduction heat transfer in the COBRA-II lumped-parameter computer code. If, however, adjacent cellular (sub-channel) centroid-to-centroid distances are used to approximate the "effective mixing lengths", significant errors are generated in the temperature distributions predicted by lumped-parameter methods. Evidence is presented which indicates that these errors in the lumped-parameter solution can be reduced by subdividing the fuel assembly into a larger number of cells. (auth)

23111 THERMAL-HYDRAULIC ANALYSIS FOR FUEL ELEMENTS WITH LIQUID-METAL. Voj, P.; Markfort, D.; Ruppert, E. (Internationale Atomreaktorbau GmbH, Bensberg, Ger.). Progr. Heat Mass Transfer; 7: 179-193(1973).

From international seminar on liquid-metal heat transfer; Trogir, Yugoslavia (6 Sep 1971).

Analytical and experimental studies are presented of the thermohydraulic behavior of a fuel rod bundle, cooled by steady-state, single-phase flow with special emphasis on liquid metals. Performance data on pressure drop, velocity distribution, and mixing rate of mock-up bundles are presented. Spacer grids typical of the design of the fuel subassembly of the SNR-300 are taken into account; and the result of an illustrative calculation of the temperature field in the spacer grid area is given. (auth)

23112 EFFECTS OF GEOMETRIC ECCENTRICITY UPON AXIAL AND AZIMUTHAL TEMPERATURE DISTRIBUTIONS IN COOLANT, CLADDING AND FUEL FOR SODIUM-COOLED ROD BUNDLES. Hofmann, F. (Kernforschungszentrum, Karlsruhe, Ger.). Progr. Heat Mass Transfer; 7: 195-205(1973).

From international seminar on liquid-metal heat transfer; Trogir, Yugoslavia (6 Sep 1971).

A theoretical analysis is presented that permits calculation of two-dimensional velocity and temperature fields in the coolant, and three-dimensional temperature fields in the fuel and cladding. The analysis is applied to sodium as coolant with fully developed turbulent flow. Mixing of the coolant is calculated by appropriate equations for the diffusivities of momentum and energy. The results for the temperature and velocity fields are presented as functions of the eccentricity of the central rod in a hexagonal array, for the following cases: pitch to diameter ratio P/D = 1.31, and displacements of the rod ξ = 0, 0.22, 0.66 mm. The results show that small displacements of the rod, in closely packed rod bundles, cause considerable temperature variations in the coolant and cladding on the rod periphery. (auth)

23113 INFLUENCE OF HEATING METHODS AND ROD ECCENTRICITIES ON TEMPERATURE MEASUREMENT IN SODIUM EXPERIMENTS. Malang, S.; Rust, K.; Tschoeke, H. (Gesellschaft fuer Kernforschung mbH, Karlsruhe, Ger.). Progr. Heat Mass Transfer; 7: 207-217(1973).

From international seminar on liquid-metal heat transfer; Trogir, Yugoslavia (6 Sep 1971).

The problem investigated concerns the accuracy with which the conditions in a sodium-cooled fuel rod bundle can be simulated by electrically heated rods in heat-transfer measurements. It turns out that up to 20% of error can be generated in the determination of the heat transfer coefficients, as a result of different structures of the simulators. The error caused by the disturbance of the heat flux due to a thermocouple with MgO insulation installed in the cladding tube is of the same order of magnitude. Much more accurate results can be achieved with thermocouples in which a BN insulation is used instead of MgO. (auth)

23114 MULTIREGION ANALYSIS OF THE EFFECT OF LATERAL ROD DISPLACEMENT ON HEAT TRANSFER IN LAMINAR FLOW THROUGH CLOSELY PACKED REACTOR FUEL RODS. Hsu, C. J. (Brookhaven National Lab., Upton, NY). Progr. Heat Mass Transfer; 7: 219-237(1973).

From international seminar on liquid-metal heat transfer; Trogir, Yugoslavia (6 Sep 1971).

A multiregion analysis of the effects of lateral rod displacement on the heat-transfer behavior of the displaced rod is presented, for longitudinal, laminar flow through closely packed rod bundles. Theoretical equations describing the temperature fields in the fuel core, cladding, and elemental coolant flow area are derived, and the series coefficients determined by constructing a set of orthonormal functions, followed by solving a matrix equation. Rod-average Nusselt numbers of the displaced rod are calculated, for the case of uniform fuel power density in the fuel core, as a function of P/D ratio, cladding thickness, thermal conductivity ratios and fractional displacement distance. (auth)

23115 FLOW AND TEMPERATURE DISTRIBUTIONS AROUND LOCAL COOLANT BLOCKAGES IN SODIUM-COOLED FUEL SUBASSEMBLIES. Kirsch, D.; Schleisiek, K. (Kernforschungszentrum, Karlsruhe, Ger.). Progr. Heat Mass Transfer; 7: 239-249 (1973).

From international seminar on liquid-metal heat transfer; Trogir, Yugoslavia (6 Sep 1971).

In an experimental investigation, the temperature distribution downstream of a blockage was measured with sodium flowing in an annular channel, the inner part of which formed six subchannels. The outer wall was an induction-heated circular tube. A distinct recirculation was found in the wake behind the blockage. The mean residence time of the fluid in the recirculation zone was calculated from the temperature measurements. A comparison between the sodium results and those obtained with water shows that heat con-

duction is negligible for the transport of heat between the flows inside and outside of the recirculation zone. Another series of experiments was performed in a water loop with a locally blocked rod bundle. The extent of the recirculation zone and the mass exchange between the flows inside and outside of this zone were measured. (auth)

23116 MIXING OF THE FLUID DUE TO HELICOIDAL WIRES ON FUEL PINS IN A TRIANGULAR ARRAY. Skok, J. (CEN de Cadarache, Saint-Paul-les-Durance, France). Progr. Heat Mass Transfer; 7: 251-262(1973).

From international seminar on liquid-metal heat transfer; Trogir, Yugoslavia (6 Sep 1971).

The results of hydraulic similarity tests on mock-ups are presented, in order to examine the mixing effect due to helicoidal wires mounted on the pins of a bundle having a triangular array. The results obtained from experiments and calculation are compared, and predictions are given of the influence of mixing on the temperature distribution of sodium in two Phenix subassemblies, as compared to the results of a calculation assuming independent channels. (auth)

23117 INCIPIENT-BOILING SUPERHEATS FOR SODIUM. Effects of History, Gas Content, and Approach to Boiling. Holtz, R. E. (Argonne National Lab., IL); Fauske, H. K.; Eggen, D. T. Progr. Heat Mass Transfer; 7: 337-343(1973).

From international seminar on liquid-metal heat transfer; Trogir, Yugoslavia (6 Sep 1971).

Experimental measurements of incipient-boiling superheats with sodium have been conducted with EBR-II primary sodium and no inert cover gas. These tests have shown that: a large incipient superheat can result in a boiling surface losing its history; if the pressure-temperature history is applied for at least 20 min. prior to the test run, the measured superheats show agreement with the pressure-temperature-history model if a ratio for the receding to advancing radii of curvature of 0.34 is employed; and the incipient-boiling superheat has been shown to be independent of the method of approach to boiling. (auth)

23118 LOCAL BOILING IN ROD BUNDLES. Gast, K. (Kernforschungszentrum, Karlsruhe, Ger.). Progr. Heat Mass Transfer; 7: 407-416(1973).

From international seminar on liquid-metal heat transfer; Trogir, Yugoslavia (6 Sep 1971).

A theoretical model is formulated to describe the process of local sodium boiling in a rod bundle geometry. The model is based on the assumption of single bubble boiling at substantial incipient-boiling superheat and considers the hydraulic characteristics of a fuel rod bundle. In the numerical calculation, the effects of liquid superheat and of the non-uniform temperature field in the disturbed region are investigated. The analytical results lead to the preliminary conclusion that, even at superheats as high as 150°C, individual vapor bubbles recondense completely within about 35 ms, that the fuel cladding inside the bubble is not overheated during this time, and that local boiling is unlikely to cause thermal hydraulic instability in the affected fuel assembly. Furthermore, it is shown that in case of considerable superheat the rapid volume change of individual vapor bubbles causes variations of the coolant flow rate at the sub-assembly outlet, which may be detected by means of an electromagnetic flowmeter. (auth)

23119 SODIUM ENTRAINMENT IN AN ARGON FLOW. The Evaporation and Condensation Processes. Egleme, M.; Michel, A. (Societe Belge pour l'Industrie Nucleaire, Brussels). Progr. Heat Mass Transfer; 7: 503-516(1973).

From international seminar on liquid-metal heat transfer; Trogir, Yugoslavia (6 Sep 1971).

In the development of sodium-cooled reactors, spent fuel assemblies may be cooled in an inert gas such as argon when they are removed from the reactor vessel or from a sodium pool. A study was made of the properties of argon mixed with sodium vapor; first, the evaporation of a thin sodium film from the fuel element surface; second, the evaporation of sodium from a pool; and third, the mechanism of trapping sodium in vapor traps. Results are given of theoretical and experimental work and conclusions are presented. (UK)

23120 MODELIROVANIE TERMODINAMICHESKIKH YAVLENII V AKTIVNOI ZONE BYSTRYKH REAKTOROV. Konferentsiya, Sostoyavshayasya 23-26 Fevralya 1970 g. v Babilone, Chekoslovakia. (Simulation Techniques in the Investigation of Thermokinetic Effects in the Core of Fast Reactors. Conference Held in Babylon, Czechoslovakia, February 23-26, 1970). Prague; Czechoslovak Atomic Energy Commission (1971). 283p. (CONF-700230-).

From international conference on simulation techniques in the investigation of thermokinetic effects in the core of fast reactors; Domazlice, Czechoslovakia (23 Feb 1970).

Eighteen papers are included on techniques and methods for calculating and measuring heat transfer and fluid flow in gas cooled and sodium cooled fast reactors. A separate abstract was prepared for each of thirteen papers. Five papers were previously abstracted for NSA and may be located under report number CONF-700230. (DG)

For abstracts of individual papers see: 21008 and 23121-23132.

23121 CALCULATION OF THE HYDRODYNAMICS AND TRANSFER IN CELLS OF FUEL ELEMENTS DURING EXTENDED FLOW. Krett, V. pp 18-36 of Modelirovanie Termodinamicheskikh Yavlenii v Aktivnoi Zone Bystrykhreaktorov. Prague; Czechoslovak Atomic Energy Commission (1971). (In Russian).

From international conference on simulation techniques in the investigation of thermokinetic effects in the core of fast reactors; Domazlice, Czechoslovakia (23 Feb 1970). CONF-700230-.

The hydrodynamics and heat exchange in triangular and square cells with smooth rods were calculated for longitudinal streamline flow. Tests were made on the use of a developed method for ribbed rods. From the experimental determination of the relation for tangential stresses on the surface of the rods, the coefficient of turbulent transfer of momentum to the tangential direction was calculated from basic integral-differential equations. This coefficient was also used to calculate the temperature field and the coefficient of heat exchange. Calculations were also made of the distribution of the rate in the transverse section of the cell by use of the Reichardt formula. (tr-auth)

23122 VELOCITY AND TEMPERATURE FIELDS DURING LAMINAR FLOW IN ECCENTRIC CHANNELS. Tetrzhev, V. pp 58-66 of Modelirovanie Termodinamicheskikh Yavlenii v Aktivnoi Zone Bystrykhreaktorov. Prague; Czechoslovak Atomic Energy Commission (1971). (In Russian).

From international conference on simulation techniques in the investigation of thermokinetic effects in the core of fast reactors; Domazlice, Czechoslovakia (23 Feb 1970). (CONF-700230-.

An analytical solution is given for the velocity and temperature fields in the case of laminar flow of sodium in circular channels with eccentric placement of the interior tubes. The velocity and temperature profiles developed assumed the heat of only the internal walls of the channels with simultaneous isolation of the external walls of the channels. The advantage of this method lies in the fact that in the given case not only the temperature field in the projected coolant is studied, but also the temperature field in the walls of the internal tubes, in the thermal insulator, and in the external walls of the channels. This makes it possible to study the effects of experiments, the ratio of external and internal radii on the temperature field, and the tangential convection in this zone as functions of heat conductivity and geometry. (tr-auth)

23123 EXPERIMENTAL STUDY OF THE TEMPERATURE FIELD OF A SODIUM LOOP WITH ECCENTRIC PLACEMENT OF THE INTERNAL FUEL ELEMENTS ($\varepsilon = 0 + 1$). Shul'ts, V. pp 68-80 of Modelirovanie termodinamicheskikh Yavlenii v Aktivnoi Zone Bystrykhreaktorov. Prague; Czechoslovak Atomic Energy Commission (1971). (In Russian).

From international conference on simulation techniques in the investigation of thermokinetic effects in the core of fast reactors; Domazlice, Czechoslovakia (23 Feb 1970). CONF-700230-.

The temperature field in circular channels with eccentrically placed internal electric heating elements was measured in experimental sodium loops heated to a maximum sodium temperature of 500°C during a maximum flow of 7000 l/hr. The measurements were made at real power values of 1.5 kW and 1.7 kW. At 2.4 kW an excessive spread of the measured values, particularly from the surface of two thermal elements, was observed, and leakage of the sodium around the seal was also observed. Some results are given graphically. (tr-auth)

23124 EVALUATION OF THE HYDRODYNAMIC PHENOMENA IN A SEVEN-ROD BUNDLE DURING AXIAL FLOW OF SODIUM. Paryzek, R.; Pashek, M. pp 112-124 of Modelirovanie Termodinamicheskikh Yavlenii v Aktivnoi Zone Bystrykhreaktorov. Prague; Czechoslovak Atomic Energy Commission (1971). (In Russian).

From international conference on simulation techniques in the investigation of thermokinetic effects in the core of fast reactors; Domazlice, Czechoslovakia (23 Feb 1970). CONF-700230-.

In experimental hexahedral cassettes with sodium cooling consisting of seven rods (EK-7), hydrodynamic conditions were studied for the purpose of determining the local heating of the coolant caused by different flow of the coolant in the individual cells. The central rod in the EK-7 cassette can deflect and for the peripheral cells triangular and ribbed spacers were provided. The calculation methods, permitting the determination of the mean velocity and a qualitative evaluation of the heating of the coolant in the individual cells of the EK-7, are described. An approximation evaluation was made of the effect of the spacers on the heating in the individual

cells in the case of central placement of the middle rod. The method for the determination of the appropriate form of the spacer promoting the achievement of equal heating in the individual cells is given. (tr-auth)

23125 EXPERIMENTAL STUDY OF THE DISTRIBUTION OF THE SHEARING STRESS ON THE WALL ACCORDING TO THE ROD PERIMETER AND THE VELOCITY FIELD IN CELLS WITH AN INFINITE BUNDLE OF SMOOTH RODS. Shimonek, I.; Mrakava, Ya. pp 126-139 of Modelirovanie Termodinamicheskikh Yavlenii v Aktivnoi Zone Bystrykhreaktorov. Prague; Czechoslovak Atomic Energy Commission (1971). (In Russian).

From international conference on simulation techniques in the investigation of thermokinetic effects in the core of fast reactors; Domazlice, Czechoslovakia (23 Feb 1970). CONF-700230-.

For investigation of the temperature conditions in complex-shaped channels it is necessary to know the distribution of the tangential stress on the surface of the rod bundle and the velocity field through its cross section. It was established that it is necessary to make the calculational methods more precise by experimental studies of the parameters of the medium. Experiments were made with smooth rod bundles with relative spacing of 2.140 and 1.615 and with ribbed rods with relative spacing of 1.300. The measurements were made on small-scale models of triangular configuration placed in the 0.370×0.214-m rectangular channel with a length of 3 m. Air at atmospheric pressure and temperature in the limits of the Reynold's number $Re = 10^5$ to 9×10^5 was used as the medium. The velocity was measured with Prandtl tubes at distances of 2.850 m from the inlet in the measurement channel at 48 points in the case of smooth rods and at 42 points in the case of ribbed rods. For measurement of the tangential stress τ_w in the case of bundles with relative spacing above 1.3 Preston tubes were used and in the case of very low values of the relative spacing transducers of the slit type were used. The experimentally established constants of the equation $U = A \cdot \ln y + B$ and $\tau_w = A \cos i\varphi$ were reported in tables as a function of the relative spacing and the Reynold's numbers. (tr-auth)

23126 EXPERIMENTAL STUDY OF MOMENTUM AND HEAT TRANSFER DURING TURBULENT FLOW OF AIR IN MODELS OF FUEL ELEMENTS. Vichek, I. pp 140-157 of Modelirovanie Termodinamicheskikh Yavlenii v Aktivnoi Zone Bystrykhreaktorov. Prague; Czechoslovak Atomic Energy Commission (1971). (In Russian).

From international conference on simulation techniques in the investigation of thermokinetic effects in the core of fast reactors; Domazlice, Czechoslovakia (23 Feb 1970). CONF-700230-.

It is known that the heat release along the diameter of reactor fuel assemblies is inhomogeneous. Accordingly the distribution of fuel elements is non-homogeneous. During the design of assemblies it was assumed that the transfer of momentum and energy between individual circles of fuel elements is absent. How correct this assumption is during turbulent coolant flow is impossible to determine theoretically, and perhaps the question can be solved experimentally. An analysis of the transfer of momentum and energy was made by means of the turbulence coefficients characterizing a given flow. The velocity and temperature fields along the radii of the assemblies with a defined geometric distribution of smooth, heated rods in the circular channels were studied experimentally. The studies were made in loops with air coolant at pressures of about 5 kg/cm^2 at $Re = 2 \times 10^5$. (tr-auth)

23127 EXPERIMENTAL STUDY OF THE THERMAL REGIME IN SEVEN-ROD MODELS OF FUEL ELEMENTS COOLED BY SODIUM (TRANSITION FLOW REGION). Pashek, M.; Paryzek, R. pp 184-191 of Modelirovanie Termodinamicheskikh Yavlenii v Aktivnoi Zone Bystrykhreaktorov. Prague; Czechoslovak Atomic Energy Commission (1971). (In Russian).

From international conference on simulation technique in the investigation of thermokinetic effects in the core of fast reactors; Domazlice, Czechoslovakia (23 Feb 1970). CONF-700230-.

The temperature range of the central rod in longitudinally streamlined seven-rod bundles with triangular lattice with relative spacing of 1.2 was studied in the region of transition flow in experimental sodium loops. The measured sodium temperature differences are shown graphically as a function of the Reynolds number. The distribution of the sodium temperature through the element cross section was studied for $20 < Re < 120$. On the basis of the investigated changes in local temperature along the perimeter of the central rod, the average value of the heat exchange coefficient was also determined. (tr-auth)

23128 METHOD FOR THE SIMULATION OF THE TEMPERATURE OF FUEL ELEMENTS. Krett, V.; Maier, I. pp 192-205 of Modelirovanie Termodinamicheskikh Yavlenii v Aktivnoi Zone Bystrykhreaktorov. Prague; Czechoslovak Atomic Energy Commission (1971). (In Russian).

From international conference on simulation techniques in the investigation of thermokinetic effects in the core of fast reactors; Domazlice, Czechoslovakia (23 Feb 1970). CONF-700230-.

The results of fuel element temperature measurements in the region of spacers in bundles of smooth and ribbed rods are described. The data obtained were compared with the data of other authors. An analysis was made of the values of longitudinal temperature gradients and methods of conversion of the measurement results obtained on simulated rods and on natural rods. The method was based on the solution of the equation of the temperature field in simulated and natural rods. (tr-auth)

23129 METHOD FOR THE STUDY OF GAS FLOW USING FREON. Shtepanek, K. pp 206-221 of Modelirovanie Termodinamicheskikh Yavlenii v Aktivnoi Zone Bystrykhreaktorov. Prague; Czechoslovak Atomic Energy Commission (1971). (In Russian).

From international conference on simulation techniques in the investigation of thermokinetic effects in the core of fast reactors; Domazlice, Czechoslovakia (23 Feb 1970). CONF-700230-.

For investigation of gas flow, the method of visualization of currents is usually used. For complex configurations of fuel elements in reactors it is very difficult to use this method directly because the current can be tracked only on the peripheral or non-enclosed regions of the fuel elements. A method was developed using freon (CF_2Cl_2) as an indicator which was admitted to the fuel element at different sites. Its distribution under the effect of turbulent and secondary flow was determined by halogen detectors in the other regions of the fuel elements. A method for the introduction of freon to the basic flow, the selection of mixtures, and the determination of concentration are described. The calibration of the halogen counter is also described. Some results using this method are reported. (tr-auth)

23130 INVESTIGATION OF THE VELOCITY PROFILE IN THE INLET REGION OF A COMPLETELY PACKED ROD BUNDLE. Subbotin, V. I.; Ushakov, P. A.; Levchenko, Yu. D.; Bibikov, L. N. (Inst. of Physics and Energetics, Olininsk, USSR). pp 222-237 of Modelirovanie Termodinamicheskikh Yavlenii v Aktivnoi Zone Bystrykhreaktorov. Prague; Czechoslovak Atomic Energy Commission (1971). (In Russian).

From international conference on simulation techniques in the investigation of thermokinetic effects in the core of fast reactors; Domazlice, Czechoslovakia (23 Feb 1970). CONF-700230-.

The results of velocity profile measurements of turbulent air flow in completely packed rod bundles are reported. Measurements were made in the region of Reynolds numbers from 15×10^3 to 100×10^3 under different inlet conditions: inlet with a sharp edge, smooth inlet, and inlet through diaphragmed tube lattice of the bundle. It was found that the length of the region of stabilization of the velocity profile depends on the inlet conditions. The length of the inlet region of the completely packed rod bundles was substantially larger than in circular tubes. It was shown that during smooth inlet the change with length of the velocity on the axis of the transverse cross section has a maximum. The change of the value of the stagnant zone with the Reynolds number is given. A method for the measurement of the velocity profile and its stabilization length are discussed. (tr-auth)

23131 USE OF ELECTROANALOGS FOR THE DETERMINATION OF THE STEADY AND NON-STEADY TEMPERATURE FIELDS IN ELEMENTS IN THE ACTIVE ZONE. Bitsa, I. pp 250-261 of Modelirovanie Termodinamicheskikh Yavlenii v Aktivnoi Zone Bystrykhreaktorov. Prague; Czechoslovak Atomic Energy Commission (1971). (In Russian).

From international conference on simulation techniques in the investigation of thermokinetic effects in the core of fast reactors; Domazlice, Czechoslovakia (23 Feb 1970). CONF-700230-.

For the determination of temperature fields in fuel elements with ribbed coatings, a modified Libman method was used which can be applied to models with constantly conducting media. Such a solution provides for the use of electrolytic models for simulation of the unsteady processes in the fuels with a continuous internal source during maintenance of a relatively high precision of the results characteristic of the model mentioned. The simulation gives a detailed representation of the local temperatures in the transverse and longitudinal sections of the fuel element and of the temperature characteristics of the coolant both within the established operating range and during fast cooling of the fuel elements after a nuclear reaction. It was shown that this method, in addition to visualization, is economical, particularly during verification of a series of variants of boundary conditions in the model. (tr-auth)

23132 EFFECT OF A HOMOGENEOUS ROUGHNESS OF THE SURFACE ON THE HYDRAULIC RESISTANCE AND HEAT TRANSFER IN A TURBULENT AIR FLOW. Shtursa, Ya. pp 262-282 of Modelirovanie Termodinamicheskikh Yavlenii v Aktivnoi Zone

Bystrykhreaktorov. Prague; Czechoslovak Atomic Energy Commission (1971). (In Russian).

From international conference on simulation techniques in the investigation of thermokinetic effects in the core of fast reactors; Domazlice, Czechoslovakia (23 Feb 1970). CONF-700230-.

For study of the effect of surface roughness of flat foils on the coefficient of resistance of friction and the heat exchange coefficient, a low-pressure air stand with rectangular 8 × 80 channels with 500 mm length was constructed. The different degrees of roughness were obtained by treatment of the heat-exchange surface of the foils by jets of steel shot. The degree of roughness was determined in accordance with Czechoslovakian standards on the mean arithmetic deviation from the mean profile line (R_a). The measurements were made in the zone of turbulent flow ($Re = 3 \times 10^4$ to 3×10^5). The measurement results were processed in the form of dimensionless relations $Nu = K \times Re^m \times Pr^{0.4}$ and $\xi = a \times Re^n$. The constants were determined as a function of the value of R_a in the region from 1 to 30 μm. The results are reported in tables and graphs. From the results obtained it resulted that with increasing roughness of the foils the friction resistance increases faster than the heat exchange. With increase of R_a from 1 μm to 30 μm and with constant Re the heat exchange coefficient doubles but the coefficient of the resistance of friction increases two and a half times. (tr-auth)

23133 ULTRASOUND QUALITY CONTROL OF THE AUSTENITIC STEEL CLADDING TUBES INTENDED FOR NUCLEAR APPLICATIONS. Guerin, F. (Vallourec, Paris). Rev. Met. (Paris); Special Edition: 41-46([nd]). (In French).

From conference on nondestructive testing on the manufacture and utilization of steel tubes; Paris, France (9 Nov 1971).

The quality control with ultrasound of the cladding tubes of the fast neutron reactor, Phenix, is described. The tubes are of small size and made of molybdenum 18/10 austenitic steel in the hyperquenched state. The techniques and control conditions used (adjustment of transducers and level of rejection), the control procedure, and the principal types of defect detected are discussed together with the difficulties encountered. (FR)

23134 STEADY STATE BURNING OF FISSION PRODUCTS IN FAST/THERMAL MOLTEN SALT BREEDING POWER REACTORS. Taube, M. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen, Switzerland). Ann. Nucl. Sci. Eng.; 1: No. 4, 283-291(Apr 1974).

The long lived fission products of a double power reactor system i.e. a fast breeder of 2000 MW(t) and a thermal "burner" of 500 MW are, in the steady state condition, "burned" in the core of the thermal reactor or "stored" in the core of the fast reactor, so that practically no radioactive wastes, with the exception of T, are released from the system. Such a steady state power system is possible for liquid fuel power reactors e.g. molten plutonium chlorides for the fast breeder and molten fluorides for the thermal burner. The neutron fluxes are estimated to be 8 to 10×10^{15} n cm^{-2} s^{-1} for the fast core and 3 to 6×10^{15} n cm^{-2} s^{-1} for the thermal core with an appropriate volume specific power of 0.22 to 0.28 MW l^{-1} and 1 to 2 MW l^{-1}.

23135 DEVELOPMENT NEEDS FOR PREOPERATIONAL AND INSERVICE INSPECTION OF FAST BREEDER REACTOR COMPONENTS. Reimann, K. J. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc., Suppl.; 19: No. 2, 4(1974).

From conference on nondestructive testing in the nuclear power industry; Columbus, OH (23 Sep 1974).

23136 RECENT ADVANCES IN NDT OF STEAM GENERATORS FOR LMFBR. McClung, R. W.; Cook, K. V.; Dodd, C. V.; Foster, B. E.; Simpson, W. A. Jr. (Oak Ridge National Lab., TN). Trans. Amer. Nucl. Soc., Suppl.; 19: No. 2, 6-7(1974).

From conference on nondestructive testing in the nuclear power industry; Columbus, OH (23 Sep 1974).

23137 NDT ACTIVITIES AT EXPERIMENTAL BREEDER REACTOR II. Whitham, G. K. (Argonne National Lab., Idaho Falls, ID). Trans. Amer. Nucl. Soc., Suppl.; 19: No. 2, 8-9(1974).

From conference on nondestructive testing in the nuclear power industry; Columbus, OH (23 Sep 1974).

23138 LECTURES ON FAST REACTORS. Wirtz, K. Karlsruhe, Ger.; Gesellschaft fuer Kernforschung mbH (1973). 312p.

The physical, technical, safety, and material problems of fast reactors are treated from the engineering and design standpoints. Topics covered include basic reactor physics and design considerations, neutronic analysis and dynamics, reactivity effects, fuel and fuel elements, design questions in fast reactor development, and safety engineering. (auth)

23139 MOLTEN PLUTONIUM CHLORIDES FAST BREEDER REACTOR COOLED BY MOLTEN URANIUM CHLORIDE. Taube, M.; Ligou, J. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen, Switzerland). Ann. Nucl. Sci. Eng.; 1: No. 4, 277-281(Apr 1974).

A fast breeder reactor of ~2000 MW(t) output using molten chlorides as fuel and coolant is discussed. Some of the most significant characteristics are: the liquid fuel contains only $PuCl_3$/NaCl; the coolant is molten UCl_3/NaCl which also forms the fertile material along with the blanket system, also UCl_3/NaCl; the coolant blanket system is divided into 2 or more independent circuits; the fuel circulates through the core, which is not divided, by forced convection. The thermal stability of the reactor is very good. Power excursions or fuel temperature transients are quickly damped by the phenomena of fuel expansion pushing part of the fissile material out of the critical zone. The loss of coolant accident results in a loss of half (or ½, ⅔) of the blanket, which, without relying on a reactor scram, results in an automatic adjustment of the reactor power level. Corrosion effects form the most difficult problem. Thermodynamic studies suggest the use of molybdenum alloys as structural materials. (auth)

23140 GBR REACTOR: AN ECONOMICALLY COMPETITIVE BREEDER. Chermanne, J. (Gas Breeder Reactor Association, Brussels). Energ. Nucl. (Milan); 21: No. 7, 421-430(Jul 1974). (In Italian).

The design is described of a 1200 MW(e) fast breeder, gas-cooled reactor (GBR-4), prepared by a group of experts of the Gas Breeder Reactor Association (GBRA) and used as a reference system for economic and safety evaluations, as well as for defining the research and development program focused on such a concept and the specifications of the prospective demonstration plant. (auth)

23141 MECHANISMS FOR VAPOR EXPLOSIONS. Bankoff, S. G. (Northwestern Univ., Evanston, IL); Fauske, H. K. Nucl. Sci. Eng.; 54: No. 4, 481-482(Aug 1974).

A simple expression is given for the isothermal reversible work of formation of a vapor lens at a liquid-liquid interface, and necessary conditions derived in terms of the spreading coefficients of the two liquids on each other. The magnitude of the interfacial tension is found to be crucial to the satisfaction of these conditions, and an approximate expression of Fowkes enables an estimate of a criterion in terms of the contributions of the London dispersion forces to the interfacial tensions. A two-step mechanism for the UO_2–Na system is also postulated. (auth)

23142 OPTIMIZATION OF CO_2 GAS TURBINE NUCLEAR POWER PLANTS. Bammert, K.; Mukherjee, S. K. (Technische Univ. Hannover (F.R. Germany). Inst. fuer Stroemungsmaschinen). Atomkernenergie; 23: No. 2, 85-98(1974). (In German).

21 figs.; 2 tabs.; 15 refs.

Information is presented on the layout and optimization of carbon dioxide power plants for large output which can be coupled with sodium cooled fast breeder in indirect cycle. According to the detailed cycle calculations three carbon dioxide cycles with different configurations were selected. Thorough investigations of the selected CO_2-cycles have shown that there exists not only an optimum pressure ratio but also an optimum base pressure. A comparison of the selected cycles has shown that all the power plants are optimum between 300 and 350 bar turbine inlet pressure regarding construction volume, construction weight, investment costs and economy. In the investigated power range the simple supercritical cycle with partial compression is most suitable. (GE)

23143 THE FAST BREEDER IS NOT YET BREEDING. Decision on Fuel Elements to be Taken in the Near Future — Construction Work in Kalkar Delayed. Sandscheper, G. VDI (Ver. Dtsch. Ing.) Nachr.; 28: No. 15, 2(Apr 1974). (In German).

The breeder reactors which have recently become operational and most of those that will be built in the near future do not convert non-fissionable material to the plutonium they need. Only during the second half of the nineties will this process make itself felt by a saving in energy resources. It is expected that by this time the materials required for this reactor type will be available. One of the main purposes of the Fast Breeder Project therefore is to develop these materials. The present state of the project is discussed. (GE)

23144 COMPARISON OF SOME CALCULATED PHYSICS CHARACTERISTICS OF THE BN-350 REACTOR WITH EXPERIMENTAL VALUES. Tinka, I. (Inst. of Nuclear Research, Rez, Czech.). Jad. Energ.; 20: No. 6, 203-205(Jun 1974). (In Czech).

A comparison of some calculated values obtained for the BN-350 reactor on the basis of programes compiled in NRI Řež with experimental values for reactor is presented. The calculated values of FEI Obninsk are included as well. (auth)

Research, Test, and Experimental Reactors

Refer also to abstracts 21187, 23099, and 23167.

23145 (AI-AEC-13117) FILTER VAPOR TRAPS FOR SODIUM OR NaK SERVICE. Guon, J. (Atomics International Div., Canoga Park, Calif. (USA)). 30 May 1974. Contract AT(04-3)-824. 77p. AT.

Tests were performed, establishing the suitability of porous metal filters as vapor traps for sodium and NaK service. Based on the results from these tests, a design method was developed to permit the sizing of filter vapor traps. Design examples are included to demonstrate the use of the design method. (6 references) (auth)

23146 (ANL-7961) ROD AND PLATE HETEROGENEITY STUDIES IN ZPPR-2. Davey, W. G.; Amundson, P. I.; Collins, P. J.; Palmer, R. G.; Keeney, W. P.; Carpenter, S. G.; Gasidlo, J. M.; Beck, C. L.; Kaiser, R. E. (Argonne National Lab., Ill. (USA)). Mar 1974. Contract W-31-109-eng-38. 73p. Dep. NTIS $5.45.

Measurements have been made in the Demonstration Reactor Benchmark, ZPPR Assembly 2, to provide physics data necessary for LMFBR design. An important objective of the ZPPR program was to test the applicability of data obtained in the plate-fueled critical to a power-reactor design with a more homogeneous composition. Sufficient fuel inventory was obtained in the form of rods which were used, within sodium-filled calandria, to build large zones in which direct comparisons of parameters could be made with those in the plate zones. A variety of quantities have been compared in the two environments. In addition to the direct reactivity worth of rod-for-plate substitution, comparisons are given for small-sample and cell-reactivity worths, neutron spectra, reaction-rate ratios, in-cell reaction rates, reaction-rate scans, sodium-void coefficient, and ^{238}U Doppler coefficient. The experiments are compared with calculations using the ARC system and ENDFB/Version-I data. Many parameters of interest can be adequately studied in the plate geometry, and the calculation methods, in general, give a good representation of the heterogeneity effects. Areas are identified in which further experimental and analytical study is needed. 17 references. (auth)

23147 (CONF-740406-21) PROGRAM PLAN FOR DECONTAMINATION AND DECOMMISSIONING THE EBR-I COMPLEX AT NRTS. Commander, J. C. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA)). 1974. 29p. Dep. NTIS $4.50.

From 2nd AEC pollution control conference; Albuquerque, New Mexico, USA (16 Apr 1974).

A program plan for decontamination and decommissioning of the Experimental Breeder Reactor-I Complex at the National Reactor Testing Station is discussed. The discussion deals with: The scope of work; decontamination problems, particularly those due to the alkali metal inventory; proposed problem solutions; program funding requirement; and a summary of the program status. (auth)

23148 (EUR-5080e) SORA SCIENTIFIC-EXPERIMENTAL PROGRAMME. (Commission of the European Communities, Ispra (Italy). Joint Nuclear Research Center). 1974. 388p. Dep. NTIS (US Sales Only) $22.50.

Information concerning the research programs performed in the SORA reactor is presented. Time-of-flight techniques and experimental facilities are described. (DCC)

23149 (HEDL-TME-74-23) PRELIMINARY DATA REPORT: POST-IRRADIATION EXAMINATION OF FUEL PINS PNL-10-23 AND PNL-10-63. Scott, J. H.; Chastain, S. A.; Arey, T. T.; Jenson, E. D. (Hanford Engineering Development Lab., Richland, Wash. (USA)). May 1974. Contract AT(45-1)-2170. 134p. AT.

Post-irradiation examination data from fuel pins PNL-10-23 and PNL-10-63 are provided for the pretransient irradiation characterization of sibling pins for the E8 experiment. The subassembly, containing 61 FTR prototypic mixed oxide fuel pins clad in 316, 20-percent CW SS, was irradiated in EBR-II from October 1970 to October 1972 and removed for interim examination. The fuel pins from PNL-10 (X-093) subassembly are being used as specimens for transient testing at both ANL and HEDL. (auth)

23150 (JAERI-M-5518) TRIAL IRRADIATION IN JMTR, 1. (Japan Atomic Energy Research Inst., Tokyo). Feb 1974. 177p. (In Japanese). NTIS (US Sales Only).

Prior to the commercial use of JMTR, a number of trial irradiations were performed from 1970 to 1971. The irradiations are described from the standpoints of: (a) design, construction, and inspection of irradiation capsules, (b) irradiation conditions and operational histories of irradiation equipment and the reactor, and (c) post-irradiation examinations. The structural, thermal, and mechanical design methods and calculations are provided for each of the capsules. The irradiation conditions included selection of irradiation lattice positions, neutron fluence, and heat generation in the capsules. Operational performance of the irradiation equipment and the reactor from the 3rd to 9th reactor cycle is described. The methods and items of post-irradiation examination are explained for each of the fuel and material loaded capsules respectively. Throughout the trial irradiations, the design, construction, and inspection of irradiated capsules proved satisfactory, and useful information and data for estimating irradiation accuracy and reactor operation efficiency were obtained. The conventional method of post-irradiation examination proved adequate. (auth)

23151 (JUL-1022-RX) RESULTS OF NEUTRON FLUX DENSITY MEASUREMENTS IN THE EXPERIMENTAL POSITIONS OF THE FRJ-1 AND THE FRJ-2 AFTER POWER INCREASE TO 10 AND 25 MW. Borchardt, G.; Lang, H.; Mexiner, C.; Muskat, S.; Schmidt, K.; Schneider, W.; Segelhorst, G.; Weise, L. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Zentralinstitut fuer Reaktorexperimente). Nov 1973. 77p. (In German). INIS.

Following the power increase in the reactors FRJ-1 and FRJ-2 in accordance with their start-up programs, the thermal, epithermal, and fast neutron flux density as well as the gamma flux density have been measured in various positions of the reactor cores. In addition, the spectrum of the fast neutrons has been determined in various irradiation positions in order to provide the data required for investigations on radiation-induced damage to materials. A representative collection of the flux density and spectral distribution data measured after the power increase is given along with a comparison of these data with values measured prior to the power increase. (GE)

23152 (JUL-1048-RX) AXIAL AND RADIAL FLUX DISTRIBUTIONS AS WELL AS NUCLEAR HEAT-UP RATES IN DIFFERENT FUEL ELEMENT POSITIONS AFTER POWER INCREASE OF FRJ-2 (DIDO) TO 25 MW, MEASURED ON BE 9.3 IN-PILE SECTIONS. Butzek, D. A.; Kuepper, H. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Zentralinstitut fuer Reaktorexperimente). Dec 1973. 64p. (In German). INIS.

The purpose of the experiment BE 9.3 (irradiation rig, loop and instrumentation) is to study the effect of the radiation in the core on the mechanical properties of reactor vessel steels. The power increase in the FRJ-2 made it necessary to check whether the BE 9.3 rigs could be further used after the change in the boundary conditions, especially with regard to their response to temperature and irradiation conditions. After a description of the experimental rig itself and possible experimental irradiation positions, the measurements of the fast flux in various irradiation positions, its axial distribution and the temperature pattern as a function of thermal power are reported. One of the main problems discussed is the nuclear heat-up due to radiation absorption (calorimetric determination of heat-up rate). (GE)

23153 (KFK-1899, pp 163-171) EXHAUST GAS MONITORING AT RESEARCH REACTORS. Jahn, H. (Kernforschungsanlage, Juelich, Ger.). Mar 1974. (In German).

Previous experience in monitoring the emission of radioactive material from the stacks of the FRJ-1 and FRJ-2 research reactors at Juelich is reported. The off-gas systems and monitoring equipment used at both reactors are described. The emission of ^{41}Ar and other radioactive aerosols and halogens were observed. Equipment is also available for monitoring tritium emission at the FRJ-2. Particular reference is given to the maximum emission values encountered during a year as well as during special incidents. Finally, recently developed equipment is described for determining by simultaneous elimination of ^{41}Ar predominantly β-active nobel gases. (tr-auth)

23154 (ORNL-TM-4412) MEASUREMENT OF CHANGES IN FLOW IMPEDANCE IN THE FUEL FAILURE MOCKUP (FFM): A LARGE-SCALE SODIUM TEST FACILITY. Wantland, J. L.; Gnadt, P. A. (Oak Ridge National Lab., Tenn. (USA)). Jul 1974. Contract W-7405-eng-26. 66p. AT.

Two flow impedance tests were made in the Fuel Failure Mockup (FFM), a large-scale sodium test facility, to determine if there were significant variations in flow resistance across a simulated fuel rod bundle for isothermal operation at elevated temperatures. Most data were taken at a nominal flow of 54 gpm and a maximum temperature of approximately 1100°F. Small changes (of the order of 5%) in the measured pressure drop across the bundle were apparent as a function of time. These changes may have been due to small cross-sectional area changes and/or very small changes in surface roughness characteristics. Changes in

flow through a purification and plugging indicator system indicated the formation of a high-temperature plugging material of unknown composition at the start of the test. The change in flow also indicated an apparent redissolving and depositing of the material in the cold trapping (purifying) system during the latter part of the test. It is possible that a surface contamination existed which changed in characteristic to cause the observed variations in flow resistance. However, the changes observed in the FFM were slight, and changes of this order of magnitude should not present a problem to large sodium systems that are equipped with properly designed and operated purification systems. (12 references) (auth)

23155 (ZJE-145) PROGRAM OF IN-CORE MEASUREMENTS. Part 2. Irradiation Experiment with Special Fuel Assemblies. Krett, V.; Kott, J.; Vicek, J. (Skoda, Plzen (Czechoslovakia)). 1974. 34p. Dep. NTIS (US Sales Only) $4.75.

A special integrated model of a fuel assembly provided with in-core instrumentation and a testing channel for a gas loop of the reactor VVR-S Řež is described. Included are the results of experimental irradiation of individual sensors and nodal points of two types of fuel assemblies (calorimetric assembly, and thermometric assembly for the measurement of throughflow and temperature) intended for accurate determination of basic physical properties of A-1 reactor core. (8 references) (auth)

23156 DOSIMETRICAL ANALYSIS OF REACTOR LEAKAGE GAMMA-RAYS BY MEANS OF SCINTILLATION SPECTROMETRY. Jun, J. S. J. Korean Nucl. Soc.; 5: No. 4, 291-309 (1973). (In Korean).

Exposure rates due to leakage gamma-rays from operating reactors TRIGA Mark II and III were measured in a horizontal plane by means of scintillation spectrometry using a 3" × 3" cylindrical NaI(Tl) detector associated with a 400 channel pulse height analyzer under varied conditions of reactor operation. In determining exposure rate due to the leakage gamma-rays at each point of measurement, Moriuchi's spectrum-exposure rate conversion theory was applied instead of using conventional response matrix method which necessitates very complicated procedures to convert a spectrum into exposure rate. The results show that a basic pattern of "typical" spectrum of the reactor leakage gamma-rays is neither affected by thermal output of the reactor, nor influenced by overall attenuation in radiation intensity. It was indicated that the attenuation of the leakage gamma-rays in air in terms of exposure rate as a whole follows an exponential law, and the total exposure rate due to the leakage gamma-rays at a certain point is nearly proportional to thermal output of the reactor. The complexity in spectrum measured for a movable core reactor, TRIGA Mark III, was analyzed through spectrum resolution, and proper judgment of the leakage gamma-rays in a complex spectrum was discussed. (Korean Sci. Abstr.)

23157 NONDESTRUCTIVE EXAMINATION OF FFTF FUELS AND OTHER CORE COMPONENTS. Spanner, J. C.; Jackson, C. N. Jr. (Westinghouse Hanford Labs., Richland, WA). Trans. Amer. Nucl. Soc., Suppl.; 19: No. 2, 8(1974).

From conference on nondestructive testing in the nuclear power industry; Columbus, OH (23 Sep 1974).

23158 RESEARCH REACTOR MUENCHEN-NEUHERBERG. Dtsch. Bauzeitschr.; No. 1, 39-42(Jan 1974). (In German).

With figs.

An illustrated documentation of the reactor construction is presented, along with a general description of the plant. (GE)

23159 CALCULATION OF THE FLUX VARIATION AND THE REACTIVITY CHANGE INDUCED BY A CENTRAL PERTURBATION IN A FAST CRITICAL ASSEMBLY. The Reduced Reactor Model. Aki, D.; Laponche, B. (CEN de Saclay, Gif-sur-Yvette, France). Nucl. Sci. Eng.; 54: No. 4, 387-394(Aug 1974).

A method is described for the analysis of experiments involving a central perturbation in a critical reactor. This method is particularly applicable to measurements dealing with reactivity changes or, as in some cases, with the variation of a fission chamber activation, in the vicinity of the perturbing sample ("local" signal). It is shown that the flux perturbation, induced by introducing the sample, can be calculated directly by solving a transport equation with a given source in the sample. This treatment, linked with the reduced reactor model, considerably shortens the required calculations. This method is applied to experiments performed in the ERMINE fast-thermal coupled critical facility at Fontenay-aux-Roses. (auth)

Propulsion and Package Reactors

23160 (AEC-tr-7565) REPORT ON THERMIONIC ACTIVITIES IN FRANCE. (USAEC Technical Information Center, Oak Ridge, Tenn.). 20 May 1974. Translation of Rapport sur les Activites Thermoelectroniques en France. 5p. Dep. NTIS $4.00.

Development programs in France for thermionic reactors are reviewed. (DCC)

23161 (GKSS-74/E/2) NS "OTTO HAHN"—TEST REPORT NO. 22 COVERING THE PERIOD FROM APRIL 14—AUGUST 24, 1973. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Geesthacht-Tesperhude (F. R. Germany)). 1974. vp. (In German). INIS.

With figs.

The operating experience gained during the first trips of the NS "Otto Hahn" after refuelling of the reactor core is reviewed. Malfunctions and the defects detected are briefly described, and a detailed account of special incidents is given in the extracts of the logbook. (GE)

23162 FLYING WITH HYDROGEN AND NUCLEAR POWER. Aviation Industry Must Have Found New Fuels at Last in the Year 2000. Mueller, K. Welt (Hamburg); No. 38, 16(Feb 1974). (In German).

The possibilities of using nuclear fission and nuclear fusion and, above all, liquid hydrogen for propulsion systems are discussed. (GE)

23163 DINAMIKA I UPRAVLENIE YADERNYM RAKETNYM DVIGATELEM. (Dynamics and Control of Nuclear Rocket Drives). Bugrovskii, V. V.; Zhukov, V. P.; Preobrazhenskii, S. S.; Solnechnyi, E. M.; Ulanov, G. M.; Chuprun, B. E. Moscow; Atomizdat (1974). 256p.

The characteristics of theoretical work in the area of the dynamics and control of nuclear rocket drives, published in the periodic literature (particularly foreign), are summarized. The mathematical apparatus, methods, and algorithms in the study of the dynamics of nuclear rocket drives and some principles of the control of the engines are given. The greatest attention is given to the distributiveness of parameters necessary for the study of the many questions of dynamics and control. (tr-auth)

Reactor Safety and Environmental Aspects

Refer also to abstracts 21060, 21062, 21071, 21089, 21108, and 23240.

23164 (AEC-tr-7559) RELIABILITY AND AVAILABILITY OF A REPAIRABLE r/m ACTIVE REDUNDANCY SYSTEM. Signoret, J. P. (CEA, 75—Paris (France). Dept. de Surete Nucleaire). Jun 1974. Translocation of SETS Report No. 20. 30p. Dep. NTIS $4.50.

A general purpose method of calculation leading to an analytical solution of which one application is given for the case of a system with 2/3 logic for constant failure rates is described. It provides means of quantitatively determining the quality of a reactor protection system as a function of its components and the maintenance policy to which it is subjected. (auth)

23165 (AEC-tr-7564) FAILURE RATE COMPILATION. Scientific Reports. Balfanz, H. P. (Institut fuer Reaktorsicherheit der Technischen Ueberwachungs-Vereine e.V., Koeln (F. R. Germany)). [nd]. Translation of IRS-W-8. 92p. Dep. NTIS $7.75.

The failure rates of mechanical and electrical components which are available from the IRS literature reserves are compiled. The compilation contains both numerical values and pertinent qualifying comments about the failure rates taken directly from the literature. Comments are given about the performance, the range of application of the components and/or the statistical data from which the failure rates have been estimated (i.e. number of observed components, the observation period and the number of failures). When possible, the failure rates of components were classified according to their range of performance or design characteristics. A differentiation of failure rates with failure modes, however, could only be made in a few circumstances. Because of the magnitude of data contained within the FARADA-Handbook, MIL-HDBK and the VDEW-Statistic the failure rates listed within these reports are summarized. A general averaging of all values, however, has not been considered to be suitable because failure rates should be chosen for specific conditions of component application. (auth)

23166 (BC-TOP-4(Rev.2)) SEISMIC ANALYSES OF STRUCTURES AND EQUIPMENT FOR NUCLEAR POWER PLANTS. Topical Report. Tsai, N. C.; Hadjian, A. H.; Kuo, P. T.; Adair, M. J.; Morrow, W. M.; Yeh, G. C. K. (Bechtel Power Corp., San Francisco, Calif. (USA)). Jun 1974. 179p.

The current, general practice within Bechtel Power Corporation for the seismic analysis of nuclear power plant structures and components is presented. The specification of design earthquakes, the establishment of the mathematical models for structures and components, and the various applicable methods of computing seismic responses are included. (auth)

23167 (CONF-740609-5) LIQUID METAL FAST BREEDER REACTOR SAFETY. Graham, J. (Westinghouse Electric Corp., Madison, PA (USA). Advanced Reactors Div.). May 1974. 14p. Dep. NTIS $4.00.

From 77th national meeting on the American Institute of Chemical Engineers; Pittsburgh, Pennsylvania, USA (2 Jun 1974).

Information on LMFBR reactor safety is presented concerning coolant reactions, local fuel failure conditions, hypothetical disruptive accidents, and containment evaluations. (DCC)

23168 (EUR-5039) PRESSURE HISTORY DURING FLASHING CAUSED BY A SUDDEN EXPANSION. Friz, G.; Riebold, W. (Commission of the European Communities, Ispra (Italy). Joint Nuclear Research Center). May 1974. 29p. Dep. NTIS (US Sales Only) $4.50. B. Fr. 50.-.

The pressure history in a flashing liquid which follows a volume step is calculated on the basis of the thin thermal layer model considering also the rise of the bubbles formed during the initial volume step. The number N of bubbles per cm^3 is introduced as a parameter. The numerical calculations were done for water in the temperature range from 280 to 340°C. N varied from 1.0 to 10^4 ($1/cm^3$). Pressure curves and the half value time t_h of return to the equilibrium pressure are presented as functions of initial water temperature, bubble number and initial pressure step. (7 references) (auth)

23169 (IRS-F-18) RESEARCH REPORTS (ANNUAL REPORTS). State: End of 1973. (Institut fuer Reaktorsicherheit der Technischen Ueberwashungs-Vereine e.V., Koeln (F. R. Germany)). Mar 1974. 336p. Dep. NTIS (US Sales Only) $20.00

Research activities in reactor safety sponsored by the Bundesminister fuer Forschung und Technologie and conducted by the Gesellschaft fuer Kernforschung and the Laboratorium fuer Reaktorregelung und Anlagensicherung are reported. (JWR)

23170 (WCAP-8171) CALCULATIONAL MODEL FOR CORE REFLOODING AFTER A LOSS OF COOLANT ACCIDENT (W REFLOOD CODE). Collier, G.; Kelly, R. D.; Spencer, A.; Waring, J. P. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). Jun 1974. 160p.

A computer code for predicting the performance of a PWR Emergency Core Cooling System during the core reflooding phase of a Loss of Coolant Accident is described. The code provides the capability of calculating variations during the core reflooding transient of basic parameters such as core flooding rate, core and downcomer water levels, fluid thermodynamic conditions (pressure, enthalpy, density) throughout the primary system, and mass flow rates throughout the primary system. Basic inputs include geometrical data, boundary conditions in the core, steam generators and containment, and ECCS injection characteristics. (auth)

23171 (WCAP-8261) WFLASH: A FORTRAN-IV COMPUTER PROGRAM FOR SIMULATION OF TRANSIENTS IN A MULTI-LOOP PWR. Esposito, V. J.; Kesavan, K.; Maul, B. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). Jul 1974. 201p.

The WFLASH program is described and the models and numerical solution of the governing conservation equations are presented. The engineering aspects of PWR's are included in the component models making up the system. A sample problem, complete with input and output descriptions, is included to facilitate the use of the program. (auth)

23172 (WCAP-8305) LOCTA-IV PROGRAM: LOSS-OF-COOLANT TRANSIENT ANALYSIS. Bordelon, F. M.; Collier, G.; Spencer, A. C.; Burman, D. L.; Ohkubo, M.; Yang, J. W. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). PWR Systems Div.). Jun 1974. 128p.

A detailed description of the LOCTA-IV heat transfer computer code is presented. LOCTA-IV evaluates fuel, cladding and coolant temperatures during a hypothetical loss-of-coolant accident. The code is used in conjunction with a loop blowdown code to determine the clad temperature transient and percent of clad reacted due to metal-water reaction following a LOCA. The effects of swelling and blockage, metal-water reaction using Baker-Just, rod-to-rod radiation heat transfer, and a modified FLECHT heat transfer correlation are included in LOCTA-IV. LOCTA-IV is part of an evaluation model which satisfies the requirements of Appendix K of 10CFR50 dated January 4, 1974. (auth)

23173 (WCAP-8306) SATAN VI PROGRAM: COMPREHENSIVE SPACE-TIME DEPENDENT ANALYSIS OF LOSS-OF-COOLANT. Bordelon, F. M.; Kelly, R. D.; Massie, H. W. Jr.; Muench, R. A.; Spencer, A. C.; Young, M. Y. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). PWR Systems Div.). Jun 1974. 243p.

A comprehensive model for analysis primarily of the blowdown phase of postulated loss-of-coolant accidents in a pressurized water reactor (PWR) is presented which satisfies the requirements "Acceptance Criteria for Emergency Core Cooling Systems for Light Water-Cooled Nuclear Power Reactors" as set forth in 10CFR50.46 (dated January 4, 1974). It can treat all phases of the initial portion of the loss-of-coolant accident commonly called the "blowdown" period and part or all of the "refill" period. It has also been applied to the simulation of other transients. Fluid conditions may be subcooled, two-phase, or superheat in any part or all of the system. Flow reversals are allowed at any location. The capability exists for countercurrent two-phase flow regimes in vertical flow paths such as the vessel downcomer or steam generator tubes and also a bubble rise flow calculation. Feedback effects of many different phenomena are incorporated in the analysis. A two-phase pump model with coastdown and cavitation, core and steam generator heat flow including DNB and transition boiling, reactivity insertion resulting from voids, and doppler effects are included. Also for core calculations the effects of clad swelling and rupture, metal-water reaction and a separate parallel hot channel calculation including cross flow effects are included. The geometrical model is variable and hence able to simulate non-standard reactor systems as well as a PWR plant. Capability exists for multiple radial-channels necessary in the core geometry for cross-flow calculations. An application of the model to a sample calculation is presented. (auth)

23174 (WCAP-8326) CONTAINMENT PRESSURE ANALYSIS CODE (COCO). Bordelon, F. M.; Murphy, E. T. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). PWR Systems Div.). Jul 1974. 52p.

An analysis of containment pressure transients following a loss-of-coolant accident is presented. A detailed examination is made of the non-linear physical phenomena occurring within the containment during the transient. Transient conditions are determined for both the containment steam-air atmosphere and the containment sump water. Temperature gradients in and heat absorption by the containment structures are also considered. The mathematical model has been incorporated into the COCO computer program. The code has the flexibility to analyze the effectiveness of engineered safeguards systems, including internal and external sprays, containment venting and pumpback, ventilation fan coolers, and a sump water recirculation cooling system. Options in the code have been provided for the recirculation cooling analysis. A plot of containment pressure versus time may also be prepared by the computer. (auth)

23175 (WCAP-8355) LONG TERM ICE CONDENSER CONTAINMENT CODE: LOTIC CODE. Grimm N. P.; Colenbrander, H. G. C. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). PWR Systems Div.). Jul 1974. 82p.

An analytical model is presented for the calculation of ice melt and long-term pressure transients in the ice condenser reactor containment after a loss-of-coolant accident. The method applies conservation equations to control volumes used to simulate spatial variation. The control volumes represent the functionally distinct compartments of the ice condenser containment. Uniform pressure and saturated steam conditions have been assumed throughout the containment in order to reduce the computing time for a given problem. Several required quantities are assumptions based on conclusions derived from Ice Condenser Test Facility test results. The code is flexible enough to analyze the effectiveness of the engineered safeguard systems, including internal and external sprays and a sump water recirculation cooling system. Temperature gradients in, and heat absorption by, the containment structure are also considered. (auth)

23176 INSURANCE OF NUCLEAR POWER PLANTS. Braun, H. (Allianz Versicherungs-A. G., Muenchen (F. R. Germany)). Atomwirtsch., Atomtech.; 19: No. 5, 226-228(May 1974). (In German).

From 7th technical Allianz colloquium; Muenchen, F. R. Germany (2 Dec 1973). 2 figs. To be published in the series 'Allianz Ber. Betriebstech. Schadenverhuetung'.

One of the functions of nuclear power plant insurance is to make the erection and operation of a nuclear power plant calculable in its economical consequences. In order to meet these requirements, a continuous dialogue between insurer and insured is necessary. Such a dialogue should be taken up during the phase of planning the nuclear power plant. (GE)

23177 PRESERVATION OF THE ENVIRONMENT AND DEVELOPMENT OF NUCLEAR POWER. Gedeonov, L. I.; Trusov,

A. G. (comp.). At. Tekh. Rubezhom; No. 12, 22-33(1973). (In Russian).

Problems of contamination of the environment in connection with development of nuclear power are discussed. From the standpoint of protecting the environment from harmful substances and maintaining natural resources, nuclear power shows many advantages: fossil fuel reserves are decreasing; transportation of fossil fuels and the resulting contamination are decreased; atmospheric aerosols, sulfur dioxide, carbon dioxide, mercury, radium, and radon in the air are decreased or eliminated; the need for trapping fumes and the formation of waste and ash piles are eliminated; and the oxygen requirement is not increased. Problems that must be solved are storage, processing, and burial of radioactive wastes; discharge of short-lived gaseous and slightly active liquid wastes; prevention of the danger of increase in worldwide accumulations of ^{3}H, ^{85}Kr, ^{129}I, ^{90}Sr, and ^{137}Cs; and prevention of potential accidental local discharges. (INIS)

23178 JOINT REACTOR SAFETY PROGRAM AT ISPRA. Wiss., Wirtsch., Polit.; 4: No. 6, 8 (Feb 1974). (In German).

The G.F.R. ministry for research and technology and EURATOM will perform a joint reactor safety research program at Ispra. The loss of coolant accident and its consequences on the emergency core cooling system will be studied using a reactor simulator with electrically heated steel tubes instead of fuel rods. (GE)

Reactor Theory and Calculation

Refer also to abstracts 22556, 22567, and 22741.

23179 (CONF-740710-3) MONTE CARLO WORK AT ARGONNE NATIONAL LABORATORY. Gelbard, E. M.; Prael, R. E. (Argonne National Lab., Ill. (USA)). Jul 1974. 34p. Dep. NTIS $4.75.

From Monte Carlo conference; Argonne, Illinois, USA (1 Jul 1974).

A simple model of the Monte Carlo process is described and a (nonlinear recursion relation between fission sources in successive generations is developed. From the linearized form of these recursion relations, it is possible to derive expressions for the mean square coefficients of error modes in the iterates and for correlation coefficients between fluctuations in successive generations. In a simple test problem, it was found that MacMillan's prescription for computing variances in means is fairly accurate. First-order nonlinear terms in the recursion relation are considered. From these nonlinear terms an expression for the bias in the eigenvalue estimator is derived, and prescriptions for measuring the bias are formulated. Plans for the development of the VIM code are outlined and the proposed treatment of small sample perturbations in VIM are briefly described. (auth)

23180 (FEI-444) REFINEMENT OF GROUP CONSTANTS AND CALCULATED VALUES OF FUNCTIONALS AS A RESULT OF A SERIES OF EXPERIMENTS ON THE CRITICAL ASSEMBLIES BFS. Van'kov, A. A.; Voropaev, A. I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1973. 45p. (In Russian). Dep. NTIS (US Sales Only) $5.25.

The results of a correction of the group constants and a series of reactor functionals are given on the basis of statistical analysis of experiments on the BFS assembly. The principles of construction of the error matrix of an integral experiment are set forth, given an estimate of them. On the basis of the results obtained, conclusions are drawn on the role of correlations of the group constants and correlations of the integral data. The contradictions caused by inadequacy of experiment and calculations are considered, along with the problems of practical application of statistical methods in the physics of fast reactors. (14 tables) (tr-auth)

23181 (INIS-mf-1355) POLYENERGETIC MILNE PROBLEM IN REACTOR PHYSICS. Study of the Influence of Anisotropic Elastic Scattering With the Heavy Gas Model. de Almeida Coco, I. (Sao Paulo Univ. (Brazil). Instituto de Fisica). Sep 1973. 110p. (In Portuguese). INIS.

Thesis.

The energy dependent Milne problem was studied in plane geometry for three absorbing and scattering media. Calculations of the energy dependent scattering cross section and linear anisotropic scattering effects were carried out. Boltzmann's equation was solved using the polynomial energetic and angular method with a $1/v$ type absorption cross section and heavy gas scattering kernel. Calculated numerical results are given for each of the three media for the energy spectrum and spatial distribution of neutrons at the vacuum-medium boundary and in the asymptotic region, the extrapolation distance, and the eigenvalues. Results are compared with data found in the literature. The numerical results show that near the boundaries and in small systems, where leakage is important, both the energy dependent scattering cross section and linear anisotropy must be included in the calculations. (auth)

23182 (ORNL-TM-4595) APPROXIMATE NUMERICAL SOLUTIONS TO THE TIME-DEPENDENT NEUTRON TRANSPORT EQUATION USING THE TASK ALGORITHM. Tomlinson, E. T. (Oak Ridge National Lab., Tenn. (USA)). Jul 1974. Contract W-7405-eng-26. 70p. Dep. NTIS $5.45.

Thesis. Submitted to Univ. of Tennessee, Knoxville.

The purpose of this work is to develop a method for obtaining approximate solutions to the time-dependent Boltzmann neutron transport equation. A transfer-scattering algorithm is used to solve the equation in the spatial, energy, and angular domains. The temporal operator is removed by assuming the neutron flux behaves as the product of a linear function and an exponential function between two given time planes. This assumed behavior is substituted into the multigroup, one-dimensional, slab geometry discrete ordinate form of the transport equation. The resultant equations are forward differenced and then cast into a form making them amenable to solution by the transfer-scattering algorithm. An exponential extrapolation of the flux is used as a convergence acceleration device. An approximation is made for the magnitude of rod drop transients to alleviate the need to use small time steps during the initial transient. Finally, a number of numerical experiments are performed to illustrate the validity of the method. These results are compared with results obtained from already existing methods. In all cases, agreement is excellent. 21 references. (auth)

23183 RECENT DEVELOPMENTS IN SPATIAL REACTOR KINETICS. Meneley, D. A. (Ontario Hydro, Toronto). pp Paper No. CNA'73-TS-2 of Proceedings of the Thirteenth Annual International Conference of the Canadian Nuclear Association. Toronto; Canadian Nuclear Association (1973).

From 13th annual international conference of the Canadian Nuclear Association; Toronto, Ontario (17 Jun 1973).

Methods for solving the equations of reactor kinetics are surveyed. They range from simple adiabatic models to expensive finite-difference methods. Point models, weighted-residual methods, modal models and quasistatic models are discussed. Some recent developments are reviewed. Two-dimensional dynamics codes using either direct finite-difference methods or flux factorization are now feasible, except perhaps for light-water reactors. Three-dimensional finite-difference codes would be very costly for design analysis, but could be used to provide reference solutions, to check simpler methods. More powerful computers may change things. (CA)

23184 OPTIMIZATION OF CONTROL-ROD PROGRAMMING IN MULTIREGION NUCLEAR REACTORS. Sekimizu, K.; Monta, K. (Nippon Atomic Industry Group Co. Ltd., Kawasaki, Japan). Nucl. Sci. Eng.; 54: No. 4, 474-481(Aug 1974).

A control-rod optimization problem is formulated for a one-dimensional multiregion reactor; that is, the end-of-life state surfaces are formulated in the N-dimensional burnup space, which is an N-dimensional Euclidean space, with its axis corresponding to the macroscopic fission cross section of each region. Solutions for a three-region reactor model are derived by using the principle of optimality. The investigation of these solutions reveals the existence of unique and nonunique solutions, depending on the relationship of end-of-life state surfaces. The relationship between two kinds of solution is discussed. (auth)

23185 ESTIMATION OF ERRORS IN REACTOR THEORY. Ronen, Y. (Atomic Energy Commission, Beer-Sheva, Israel). Nucl. Sci. Eng.; 54: No. 4, 467-470(Aug 1974).

A larger scope for the functional analysis method for error estimation is obtained by introducing the L_1 space to the calculations. The advantages of introducing the L_1 space are the possible close estimation of errors and a simplification of the calculations. Introduction of the L_1 space to reactor physics problems gives also some special meanings to the interpretation of errors, because this is the natural space for reactor theory problems. The method is illustrated by some examples, dealing with the multigroup diffusion equation, where errors in eigenvalues and in fluxes are estimated and compared with the actual errors. (auth)

23186 APPLICATION OF THE FINITE ELEMENT METHOD TO TWO-DIMENSIONAL DIFFUSION PROBLEMS. Deppe, L. O.; Hansen, K. F. (Massachusetts Inst. of Tech., Cambridge). Nucl. Sci. Eng.; 54: No. 4, 456-465(Aug 1974).

An application of the finite element method to a typical pressurized water reactor configuration is presented. Results of using various coarse-mesh approximations are compared with fine-mesh finite difference calculations. The results indicate that reasonable

eigenvalues and reaction rates can be calculated using very coarse meshes. (auth)

23187 TEMPERATURES, STRESSES, AND DEFORMATIONS OF NUCLEAR REACTOR FUEL ELEMENTS. Alujevic, A. Tehnika (Belgrade); 27: No. 6, 141b-144b(1972). (In Serbo-Croatian).

While the irradiation damage, which is the cause of the material shrinkage, is strongly temperature dependent, the changes of the temperature distribution in turn influence the deformations of the pin and the stresses developed. Therefore the reactor channel heat transfer calculations and the fuel pin deformation calculations must be performed simultaneously. To this end, a stress/deformation computer code was combined with a channel heat transfer/fluid flow routine. (Bull. Sci. Sect. A)

23188 CONTINUOUS SLOWING DOWN THEORY INCLUDING ELASTIC AND INELASTIC SCATTERING. Yamamura, Yasunori (Okayama Coll. of Science (Japan). Dept. of Applied Physics); Sekiya, Tamotsu (Osaka Univ., Suita (Japan). Dept. of Nuclear Engineering). Atomkernenergie; 23: No. 2, 121-125(1974).

5 figs.; 10 refs.

The continuous slowing down (CSD) theory of the Wigner-type is applied to the treatment of elastic and inelastic moderations of fast neutrons in a fast reactor assembly. The present CSD theory is not based on the Taylor expansion of the integrands as most CSD theories are. Only one moderating parameter in the present CSD theory is iteratively given as a function of the transfer probability for the slowing down channel and the neutron flux. The converged flux is the desired solution itself. For rapid and precise computation of the above-defined moderating parameter the separate-type synthetic kernel is employed for each slowing down channel. The numerical calculations of the moderating parameters are performed for various media containing resonant elements and it is shown that the present CSD theory gives very accurate space-independent solution for a representative fast reactor composition. The practical interest of this CSD theory is its rapid convergence. (GE)

Reactor Components and Accessories

Refer also to abstracts 20951, 20952, 20976, 21243, 21665, 21737, 21815, and 21831.

23189 (BC-TOP-5(Rev.2)) PRESTRESSED CONCRETE NUCLEAR REACTOR CONTAINMENT STRUCTURES. Reuter, H. R.; Chang-Lo, P. L. C.; Pfeifer, B. W.; Shah, G. H.; Whitcraft, J. S. (Bechtel Power Corp., San Francisco, Calif. (USA)). Jun 1974. 477p.

A discussion of the techniques and procedures used for the design of prestressed concrete nuclear reactor containment structures is presented. A physical description of existing containment structures is presented. The design bases and load combinations are given for anticipated conditions of service. Reference design documents which include industry codes, specifications, AEC Regulatory Guides, Bechtel Topical Reports and additional criteria as appropriate to containment design are listed. Stepwise procedures typically followed by Bechtel for design of containments is discussed and design examples are presented. A description of currently used analytical methods and the practical application of these methods for containment design is also presented. The principal containment construction materials are identified and codes of practice pertaining to construction procedures are listed. Preoperational structural testing procedures and post-operational surveillance programs are furnished along with results of tests on completed containment structures. (auth)

23190 (GAI-1766) REVIEW OF EVAPORATIVE AND NON-EVAPORATIVE COOLING SYSTEMS. Momose, K. T.; Sebald, J. F.; Haman, L. L. (Gilbert Associates, Inc., Reading, Pa. (USA)). 18 Feb 1972. 88p.

A review of the various evaporative and dry types of cooling towers is presented together with a discussion of the problems associated with each type. (DG)

23191 (ZJE-148) COOLANT DYNAMICS AND VIBRATIONS OF REACTOR COMPONENTS. Pecinka, L. (Skoda, Plzen (Czechoslovakia)). 1974. 24p. Dep. NTIS (US Sales Only) $4.25.

The nuclear power plant operation is associated with dynamic effects —both in reactor coolant and in primary circuit components. The classification of exciting forces is given and the laws of their propagation are described. Using the method of statistical energy analysis, the calculation procedure of dynamic response for gas cooled components is shown. Finally the possibilities of power plants operational diagnostics with respect to dynamic effects are discussed. 14 references. (auth)

23192 NONDESTRUCTIVE TESTING IN THE NUCLEAR POWER INDUSTRY. Conference Held at Columbus, Ohio, September 23–25, 1974. Farmakes, R. (ed.). Trans. Amer. Nucl. Soc., Suppl.; 19: No. 2, 1-20(1974).

Summaries of twenty four papers given at the Sept 1974 American Nuclear Society Conference on Nondestructive Testing are presented. (DG)

For abstracts of individual papers see: 23066, 23075, 23135–23137, 23157, 23192–23204, 23219, 23222, and 23255–23257.

23193 NONDESTRUCTIVE TESTING IN THE NUCLEAR POWER INDUSTRY. McMaster, R. C. (Ohio State Univ., Columbus). Trans. Amer. Nucl. Soc., Suppl.; 19: No. 2, 1(1974).

From conference on nondestructive testing in the nuclear power industry; Columbus, OH (23 Sep 1974).

23194 NDE IN NUCLEAR POWER PLANT CONSTRUCTION. Straiton, R. W. (Bechtel Power Corp., San Francisco). Trans. Amer. Nucl. Soc., Suppl.; 19: No. 2, 2(1974).

From conference on nondestructive testing in the nuclear power industry; Columbus, OH (23 Sep 1974).

23195 STATE-OF-THE-ART REVIEW NONDESTRUCTIVE TESTING AS APPLIED TO NUCLEAR PRESSURE VESSELS AND COMPONENTS. Forrer, G. R. (G. R. Forrer and Assoc., Baberton, OH); Sattler, F. J. Trans. Amer. Nucl. Soc.; 19: No. 2, 4(1974).

From conference on nondestructive testing in the nuclear power industry; Columbus, OH (23 Sep 1974).

23196 ULTRASONIC DETECTION OF IRREGULARLY ORIENTED DEFECTS IN ZIRCONIUM ALLOY TUBING. Patel, H. B. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Trans. Amer. Nucl. Soc., Suppl.; 19: No. 2, 4-6(1974).

From conference on nondestructive testing in the nuclear power industry; Columbus, OH (23 Sep 1974).

23197 ULTRASONIC EXAMINATION OF REACTOR VESSELS AFTER THE SHOP HYDROSTATIC TEST. Caplan, J. S. (Westinghouse Electric Corp., Pittsburgh). Trans. Amer. Nucl. Soc., Suppl.; 19: No. 2, 7(1974).

From conference on nondestructive testing in the nuclear power industry; Columbus, OH (23 Sep 1974).

23198 INITIAL RESULTS OF A HOLOGRAPHIC TOMOSYNTHESIS TECHNIQUE FOR FUEL-CORE INSPECTION. Ellingson, W. A.; Read, A. A.; Riley, W. F. (Iowa State Univ., Ames). Trans. Amer. Nucl. Soc., Suppl.; 19: No. 2, 10-11(1974).

From conference on nondestructive testing in the nuclear power industry; Columbus, OH (23 Sep 1974).

23199 INSERVICE EXAMINATION OF NUCLEAR UNITS. No Hands. Bailey, E. C. (Commonwealth Edison Co., Chicago). Trans. Amer. Nucl. Soc., Suppl.; 19: No. 2, 12(1974).

From conference on nondestructive testing in the nuclear power industry; Columbus, OH (23 Sep 1974).

23200 INSERVICE INSPECTION OF NUCLEAR POWER COMPONENTS. Lautzenheiser, C. E. (Southwest Research Inst., San Antonio, TX). Trans. Amer. Nucl. Soc., Suppl.; 19: No. 2, 13 (1974).

From conference on nondestructive testing in the nuclear power industry; Columbus, OH (23 Sep 1974).

23201 POSTIRRADIATION EXAMINATION AT BATTELLE–COLUMBUS LABORATORIES. Scotti, V. G. (Battelle–Columbus Labs., Columbus, OH). Trans. Amer. Nucl. Soc., Suppl.; 19: No. 2, 13-14(1974).

From conference on nondestructive testing in the nuclear power industry; Columbus, OH (23 Sep 1974).

23202 ACOUSTIC EMISSION MONITORING OF NUCLEAR PRESSURE VESSELS. Bell, R. L.; Kelly, M. P.; Dunegan, H. L. (Dunegan/Endevco, San Juan Capistrano, CA). Trans. Amer. Nucl. Soc., Suppl.; 19: No. 2, 14-15(1974).

From conference on nondestructive testing in the nuclear power industry; Columbus, OH (23 Sep 1974).

23203 REMOTELY CONTROLLED AND MONITORED ULTRASONIC WELD TEST SYSTEM FOR THE INSPECTION OF CIRCUMFERENTIAL PIPE WELDS. De Walle, S. (Superior Electronics Industries Ltd., Toronto). Trans. Amer. Nucl. Soc., Suppl.; 19: No. 2, 15-16(1974).

From conference on nondestructive testing in the nuclear power industry; Columbus, OH (23 Sep 1974).

23204 FUTURE ROLES FOR NONDESTRUCTIVE TESTING IN THE NUCLEAR INDUSTRY. Vancil, J. (Choctaw Service and

Supply Co., Tulsa, OK). Trans. Amer. Nucl. Soc., Suppl.; 19: No. 2, 19(1974).
From conference on nondestructive testing in the nuclear power industry; Columbus, OH (23 Sep 1974).

23205 SOME NDT METHODS FOR FUTURE NEEDS. Sharpe, R. S. (NDT Centre, Harwell, Eng.). Trans. Amer. Nucl. Soc., Suppl.; 19: No. 2, 19-20(1974).
From conference on nondestructive testing in the nuclear power industry; Columbus, OH (23 Sep 1974).

23206 RIDDLE OF BONDED AND UNBONDED TENDONS IN PRESTRESSED CONCRETE REACTOR VESSELS. Bangash, Y. (Thomas Polytechnic, London). Concrete; 8: No. 6, 46-48(Jun 1974).
Arguments for and objections to the use of bonded and unbonded tendons in prestressed concrete reactor pressure vessels are presented. A theoretical analysis based on a two-dimensional finite element is developed for computing bond stresses between the type and size of a tendon and the surrounding concrete. Finally, on the basis of bond stress investigation, various tendons and their sizes are recommended to be classified under bonded and unbonded schemes when they are used in prestressed concrete reactor vessels. (UK)

23207 STEAM GENERATORS IN NUCLEAR POWER STATIONS. Leardini, T. Energ. Nucl. (Milan); 21: No. 6, 341-352 (Jun 1974).
The experience acquired with the steam generators of the stations at Garigliano, Latina and Trino Vercelleso is described. The functional features of proven-type steam generators and their main constructional aspects are considered with special reference to the choice of the material for the tube bundle. The steam generator piping is discussed from the standpoint of the chemical treatment of the secondary circuit coolant. The problems associated with inspections and repairs, such as in-service leak detection, decontamination methods, and techniques to cut out damaged tubes are illustrated. Brief reference is made to the interdependence between the performance of the steam generator and that of the other secondary circuit components, such as the turbine and condenser. (auth)

23208 MATCHING ENGINE-GENERATOR SYSTEMS TO NUCLEAR CORESPRAY REQUIREMENTS. Hartung, E. C. Power Eng.; 78: No. 7, 52-55(Jul 1974).
A description is given of a computer model which permits the combining of characteristics of individual components of engine-generator sets in order to optimize the design of the entire core-spray system. (DG)

23209 ITALIAN NUCLEAR ACTIVITY IN 1973. Battistini, G. (CNEN, Rome). Com. Naz. Energ. Nucl., Notiz.; 20: No. 5, 25-38(May 1974). (In Italian).

23210 METHODS FOR THE MEASUREMENT OF FLUID LOSSES IN NUCLEAR COMPONENTS. Santarelli, E. Com. Naz. Energ. Nucl., Notiz.; 20: No. 5, 72-74(May 1974). (In Italian).

23211 PROBLEMS IN THE EVALUATION OF EMERGENCY CORE COOLING. Farber, G. (Institut fuer Reaktorsicherheit der Technischen Ueberwachungs-Vereine e.V., Koeln (F.R. Germany)). Tech. Ueberwach.; 15: No. 3, 88-92(Mar 1974). (In German).
1 tab.; 3 refs. Also issued as AED-Conf-73-500-005.
A survey of the topics dealt with during the IRS-colloquium 1973 is given. Therefore, this contribution is concerned with the mathematical/physical analyses and experimental work referring to the LOCA, as well as the difficulties involved. Problems of timing are presented as well as safety criteria for the estimation of ECCS, the possibilities of ECCS improvement and methods of the reliability technique used for system examinations. Topics being dealt with in detail within the following contributions are only summarized in this survey. Design examination and acceptance control, which will be performed by the Technical Surveillance Associations, are not discussed. (GE)

23212 RELIABILITY RESEARCH IN ELECTRIC POWER ENGINEERING. Edwin, K. W. (Technische Hochschule Aachen (F.R. Germany). Inst. fuer Elektrische Anlagen und Energiewirtschaft). Elektrizitaetswirtschaft; 73: No. 9, 243-247(Apr 1974). (In German).
8 figs.; 5 refs.
Reliability research will grow in importance in electric power engineering, since this is a most dynamic field which will continue to call for the development of new techniques for the generation and distribution of electric power. Suitable methods have to be found to establish reliability criteria based upon standardized and appropriate parameters, and the problems associated with the definition and determination of such parameters are discussed. (GE)

Reactor Fuels

Refer also to abstracts 20828-20835, 20839, 21511, 21515, 21516, 21519-21521, 21545, 21591, 21665, and 21839.

23213 (AED-Conf-74-116-002) THE EFFECTS OF LOAD FOLLOWING OPERATION ON FUEL RODS. Aas, S. 1974. 13p. INIS.
From VGB conference, "research in power plant engineering"; Essen, F. R. Germany (26 Mar 1974).
7 figs.; 28 refs.
The objective is to examine under which conditions changes in heat output from a rod of the magnitudes indicated can lead to defects in the cladding of the fuel. The word "conditions" is used here in a wide sense, that is not only operational conditions but also fuel design parameters and irradiation history, because they all determine the final behavior of the rod. (GE)

23214 (HEDL-TME-74-16) ANALYSIS OF TEMPERATURE PROFILES IN TRANSIENTLY HEATED UO_2 USING MOLYBDENUM INCLUSIONS. Wilmot, E. L. (Hanford Engineering Development Lab., Richland, Wash. (USA)). [nd]. Contract AT(45-1)-2170. 23p. AT.
An internal temperature indicator has been developed for determining a radial temperature gradient in UO_2 pellets. This indicator is a porous molybdenum inclusion that changes in morphology when melted. The indicator provides a dramatic and identifiable experimental temperature isotherm and makes possible a direct correlation of HEATING IV predictions with experiments involving thermal transients. Such a correlation was performed, and the results indicated good agreement between calculations and experiments. (5 references) (auth)

23215 (JAERI-M-5628) COMPUTER PROGRAMS FOR THE ANALYSIS OF FUEL-ROD BEHAVIORS. Harayama, Y.; Morishima, A.; Izumi, F.; Fujita, M.; Yamada, R. (Japan Atomic Energy Research Inst., Tokyo). Mar 1974. 90p. (In Japanese). NTIS (US Sales Only).
Availability and necessity of the computer program for analyzing the behavior of fuel rods are described, and features of the programs are explained. (auth)

23216 (KFKI-74-23) COBRA-3/KFKI, A DIGITAL COMPUTER PROGRAM FOR STEADY STATE AND TRANSIENT THERMAL-HYDRAULIC SUBCHANNEL ANALYSIS OF ROD BUNDLE NUCLEAR FUEL ELEMENTS. Kovacs, L. M.; Vigaissy, J.; Toth, I. (Kozponti Fizikai Kutato Intezet, Budapest (Hungary)). 1974. 20p. Dep. NTIS (U. S. Sales Only) $4.00.
COBRA-3/KFKI is a digital computer program for ICL-1905 computer in FORTRAN language. The program is a revised version of the original COBRA-3 code. The code calculates the steady-state and transient flow and enthalpy transport in rod-bundle nuclear fuel elements in both boiling and nonboiling conditions. The mathematical model is formulated by dividing the bundle flow area into flow subchannels that are assumed to contain one-dimensional flow and are coupled to each other by turbulent and diversion crossflow mixing. The program neglects sonic velocity propagation and neglects temporal and spatial acceleration of the diversion crossflow in the transverse momentum equation. A semiexplicit finite-difference scheme is used to perform a boundary-value solution where the boundary conditions are the inlet enthalpy, inlet flow rate, and exit pressure. (5 references) (auth)

23217 (RT/ING-(74)6) METHOD OF MODELS IN THE REPRODUCTION OF THE BURN-OUT PHENOMENON OF WATER WITH FREON. Cumo, M.; Maciuca, C.; Moronesi, M.; Palazzi, G. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). Feb 1974. 31p. (In Italian). Dep. NTIS (US Sales Only) $4.75.
Scaling theory with particular reference to burnout phenomena is revised and assessed. As application, the conclusion of an original research on burnout performed at the Reactor Technology Laboratory of the CNEN is shown. (auth)

23218 (TUBIK-30) CALCULATION OF THE TEMPERATURE DISTRIBUTION FOR AN ECCENTRIC SPHERICAL LAYER WITH CONSTANT HEAT FLUX ON INNER SURFACE AND CONSTANT TEMPERATURE ON OUTER SURFACE. Sprenger, H.; Wolf, L. (Technische Univ. Berlin (F. R. Germany). Inst. fuer Kerntechnik). Apr 1974. 74p. (In German). Dep. NTIS (US Sales Only) $6.75.
The steady-state temperature distribution in an eccentric spherical layer is determined by two different methods of solution using bispherical coordinates. Both methods take advantage of the

orthogonality properties of Legendre functions and lead to a system of nonhomogeneous, linear, algebraic equations of infinite order which is solved after truncation. When applied to heat conduction in the eccentric coating layer of a coated fuel particle, both methods yield corresponding results for the temperature distribution. From the numerical results, some indication has been found as to explain why TRISO-type particles are more susceptible to occurrence of the amoeba effect than BISO-type particles. (auth)

23219 FUEL ELEMENT END CAP FOR LEAK DETECTION. Worlton, D. C.; Ryden, J. Jr. (to Jersey Nuclear Co.). US Patent 3,823,068. 9 Jul 1974. Filed date 22 Nov 1971. 8p.

Nuclear reactor fuel element leakage can now be determined without removing the fuel elements from the reactor core by employing an upper fuel element end cap having a flexible means which is sensitive to pressure changes within the fuel element and which activates an eddy current effecting means, and by placing an eddy current near the end cap. (auth)

23220 TECHNIQUE FOR ULTRASONIC INSPECTION OF END-CAP WELDS ON THIN-WALLED FUEL ELEMENTS. van den Andel, J. (Westinghouse Canada Ltd., Hamilton, Ont.). Trans. Amer. Nucl. Soc., Suppl.; 19: No. 2, 9-10(1974).

From conference on nondestructive testing in the nuclear power industry; Columbus, OH (23 Sep 1974).

23221 HEAT TRANSFER TIME CONSTANT OF A FUEL PIN MEASURED BY CROSS-CORRELATION METHODS. Puch, B.; Robinson, E. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Geesthacht-Tesperhude (F.R. Germany). Inst. fuer Physik). Atomwirtsch., Atomtech.; 19: No. 4, 181-182(Apr 1974).

4 figs.; 4 refs.

In a simplified model the heat transfer from the fuel to the coolant is depenent on the heat resistance $R_{(fw)}$ between fuel and coolant and the heat capacity $C_{(f)}$ of the fuel. This model should be adequate in a rather low frequency range, frequencies below 0.1 Hz. (GE)

Reactor Control Systems

23222 (AECL-4831) SHUTOFF ROD EXPERIMENTS IN ZED-2. Okazaki, A.; Walker, D. H. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). May 1974. 77p. Dep. NTIS (US Sales Only) $7.00. AECL $2.00.

Four sets of experiments were performed in the ZED-2 reactor to provide data to check methods of calculation of shutoff rod designs for future CANDU (Canada Deuterium Uranium) reactors: (1) the reactivity effects of possible shutoff rod materials (Hf, Dy, Gd-Al, Sm-Al and plasma-sprayed Gd_2O_3-Ni) were compared with that of Cd, (2) the reactivity effects of voiding two different shaped guide tubes were measured, (3) the reactivity effects of rectangular channel, box and curved plate absorbers were compared with that of the Pickering shutoff rod, and (4) the interaction between two absorbers separated by 1 and 2 lattice pitches was studied. The reactivity effects were obtained by measurements of the critical height. Some period measurements were also made. Flux distributions were measured. The experimental results are presented, and no interpretation in terms of the reactivity effects in any proposed power reactor is given. (auth)

23223 ACOUSTIC MONITORING SYSTEMS EVALUATION IN NUCLEAR POWER PLANTS. Gopal, R. (Westinghouse Electric Corp., Pittsburgh). Trans. Amer. Nucl. Soc., Suppl.; 19: No. 2, 16-17(1974).

From conference on nondestructive testing in the nuclear power industry; Columbus, OH (23 Sep 1974).

23224 REACTOR PHYSICS ASPECTS OF BOOSTERS VS ABSORBERS FOR XENON OVERRIDE IN LARGE CANDU REACTORS. Dastur, A. R.; Trojan, O. A. (Atomic Energy of Canada Ltd., Chalk River, Ont.). pp Paper No. CNA'73-TS-1 of Proceedings of the Thirteenth Annual International Conference of the Canadian Nuclear Association. Toronto; Canadian Nuclear Association (1973).

From 13th annual international conference of the Canadian Nuclear Association; Toronto, Ontario (17 Jun 1973).

In reactors of the Canadian type, booster rods have mainly been used instead of neutron-absorbing adjuster rods to override poisoning by xenon and to provide axial power flattening. Local xenon-induced fluctuations of power in the core can be controlled more easily by booster rods. However, for reactors of the size of those being built at Bruce (750 MW(e)), boosters show an insignificant cost advantage over adjuster rods even if they are used only to override the effect of poisoning out, and if load-following is incorporated in the design, booster rods will be much more expensive than adjusters. (CA)

23225 STANDARD CONSTRUCTION OF CONTROL SYSTEMS FOR PRESSURIZED-WATER POWER REACTORS. Maslenok, B. A.; Voskoboinikov, V. V. (comp.). At. Tekh. Rubezhom; No. 12, 14-22(1972). (In Russian).

1972.

Higher power output levels of single-unit PWR and BWR power plants have led to the use of various control systems with a large number of functions for regulating the power of the reactor and ensuring its safe operation. Analysis of the construction of the drive mechanisms used on different reactors has clarified not only the direction of their development but also indicated the best type of construction. For a pressurized-water reactor, an electromagnetic mechanism is most often used, while for boiling reactors, a hydraulic mechanism seems to be preferred. A number of such mechanisms which are used on the reactors at different nuclear power stations are described. (INIS)

23226 CONTROL OF THE THTR POWER STATION, Uentrop. Friedrich, K. BBC-Nachr.; 56: No. 4, 120-127(1974). (In German).

9 figs.; 2 refs.

THTR power stations provide one possibility of meeting the ever-increasing power requirements of industrial nations. The control scheme of the 300 MW(e) THTR power station is described. (GE)

23227 DIRECT DIGITAL ESTIMATION OF POWER DENSITY SPECTRA FROM NUCLEAR REACTORS. Hoermann, H. A. Regelungstech. Prozess-Datenverarb.; 22: No. 1, 11-17(Jan 1974). (In German).

7 figs.; 1 tab.; 9 refs. Part of a thesis of the TH Muenchen.

During the digital on-line estimation of power density spectra over wide frequency ranges, problems with regard to capacity and speed will arise due to the use of medium-scaled process computers. A direct approach using a coarse prefiltering technique is presented which, in contrast to the Fast Fourier Transform, allows a resolution proportional to the center frequency without the necessity of extensive data storage. (GE)

23228 CALCULATION OF CONTROL ROD EFFICIENCY IN OTTO-PEBBLE BED REACTORS. Feltes, W.; Wilhelm, H. (Internationale Atomreaktorbau G.m.b.H. (INTERATOM), Bensberg/Koeln (F.R. Germany). Abt. fuer Physik und Mathematik). Atomwirtsch., Atomtech.; 19: No. 5, 237-238(May 1974). (In German).

2 figs.; 2 tabs.; 2 refs.

The calculation of control rod efficiencies in pebble bed reactors by means of the three-dimensional Monte-Carlo code MOCA is described. The data are then compared with the results of two-dimensional diffusion calculations (DIXY) where the absorber rods are considered in a ring model. (GE)

Nuclear Power Plant Economics

Refer also to abstract 23091.

23229 NUCLEAR POWER PLANTS IN THE USA. Development and Prospects. Kroms, A. Elektrotech. Z., 26B: No. 4, 74-76(Feb 1974). (In German).

3 figs.; 9 refs.

A brief survey is given of the current situation on the nuclear power plant market in the USA, followed by a general review of future developments and projects to meet the projected energy requirements up to the year 1990. (GE)

23230 EXPORT FINANCING OF NUCLEAR POWER PLANTS. Deeken, K. Atomwirtsch., Atomtech.; 19: No. 5, 228-233(May 1974). (In German).

The financing of nuclear power plants is of decisive importance for the export with respect to the competitive situation in relation to other countries. The export financing system of the German Federal Republic offers several possibilities of financial assistance during the erection of the nuclear power plant and after its handing over to the purchaser by various credit institutes, which are described in detail. A comparison with the financing systems in other countries, especially USA, France, Great Britain, and Japan shows that the German export financing is not competitive in many cases and therefore has to be reformed. (GE)

23231 FUTURE VARIANTS ON THE CANDU THEME. Mooradian, A. J. (Atomic Energy of Canada Ltd., Chalk River, Ont.). pp Paper No. CNA'73-601 of Proceedings of the Thirteenth Annual International Conference of the Canadian Nuclear Association. Toronto; Canadian Nuclear Association (1973).

From 13th annual international conference of the Canadian Nuclear Association; Toronto, Ontario (17 Jun 1973).

Future developments of the CANDU reactor will be in two major directions: (1) a commercial reactor program based on the PHWR and near term prospects for the BLWR; (2) a long term program centering on the extension of fuel resources by way of the OCR program, plutonium recycle, the thorium cycle and electronuclear breeding. (CA)

23232 NUCLEAR POWER IN ONTARIO. Smith, H. A. (Ontario Hydro, Toronto). pp Paper No. CNA'73-201 of Proceedings of the Thirteenth Annual International Conference of the Canadian Nuclear Association. Toronto; Canadian Nuclear Association (1973).

From 13th annual international conference of the Canadian Nuclear Association; Toronto, Ontario (17 Jun 1973).

The present achievements of the nuclear power industry in Ontario, brought about by the close association of Ontario Hydro and Atomic Energy of Canada Limited, are reviewed in detail. Recent experience and performance at Douglas Point G. S. are discussed and new solutions to major problems are outlined. The history of the design, construction, and commissioning of the four Pickering units is summarized along with heavy water management and fuel handling progress on the Bruce Generating Station, currently under construction, is also reviewed with mention of the changes that have been made from the Pickering design to reduce maintenance requirements and D_2O upkeep costs. Ontario Hydro's nuclear studies program for future installations includes: (i) cost reduction by duplicating existing stations, (ii) design improvements to the Bruce Station, (iii) preliminary engineering studies of the 4×1200 MWe Candu nuclear stations, and (iv) assessments of Light Water Reactors. The conclusion is reached that the Candu system can meet the province's needs for a considerable time into the foreseeable future. (CA)

23233 COMPARATIVE ECONOMIC IMPACT OF FOSSIL, NUCLEAR, AND HYDRO-ELECTRIC STATIONS. Howard, J. S. (National Energy Board, Ottawa). pp Paper No. CNA'73-501 of Proceedings of the Thirteenth Annual International Conference of the Canadian Nuclear Association. Toronto; Canadian Nuclear Association (1973).

From 13th annual international conference of the Canadian Nuclear Association; Toronto, Ontario (17 Jun 1973).

The technical and cost factors involved in the selection of electrical power plants in Canada today are examined. Hydro, fossil-fuel and CANDU nuclear power stations are compared with respect to their varying impacts on the economy and discussed from the point of view of capital costs, energy costs, initial investments, operating costs, and minor incentives and restrictions. (CA)

23234 FINANCIAL RESOURCES REQUIRED FOR THE FUTURE NUCLEAR POWER PROGRAM. Foster, J. S. (Atomic Energy of Canada Ltd., Chalk River, Ont.). pp Paper No. CNA'73-502 of Proceedings of the Thirteenth Annual International Conference of the Canadian Nuclear Association. Toronto; Canadian Nuclear Association (1973).

From 13th annual international conference of the Canadian Nuclear Association; Toronto, Ontario (17 Jun 1973).

The amount of extra effort, measured in terms of dollars, required to develop Canada's nuclear power program during the remainder of this century is estimated as the sum of the extra expenditures to be made by the power utilities and industry and the net expenditures for certain facilities and services which are very specific to the nuclear program. The three main extra financial requirements would be: (1) the investment by the utilities in capital intensive nuclear power stations, (2) the investment in heavy water production, and (3) research and development expenses. The underlying assumptions on which the predictions are based, such as forecasts of provincial demand for nuclear power, are briefly outlined. (CA)

23235 NUCLEAR PROJECTS OF HYDRO-QUEBEC. Cahill, L.; Monier, L. F. (Hydro-Quebec). pp Paper No. CNA'73-202 of Proceedings of the Thirteenth Annual International Conference of the Canadian Nuclear Association. Toronto; Canadian Nuclear Association (1973).

From 13th annual international conference of the Canadian Nuclear Association; Toronto, Ontario (17 Jun 1973).

Hydro-Quebec entered the nuclear field in 1965 by participating in the Gentilly Nuclear Station Project Unit No. 1. Hydro Quebec personnel participated actively in the preliminary and detailed studies. In addition, it had the responsibility for the construction, the commissioning and the operation of the station on behalf of AECL. The operational highlights of Gentilly-1 during the past year are given. Hydro-Quebec decided to begin the construction of a second unit on the Gentilly site. To continue its evolution in the nuclear field, Hydro-Quebec will retain the services of the Atomic Energy of Canada Limited and Canatom Limited which will undertake the design of the nuclear part and the conventional part of the station respectively. A general description of the station, definitions of the criteria, and requirements which determine the choice of components are presented together with an outline of the project organization. (auth)

23236 KARACHI NUCLEAR POWER PLANT AS A PART OF THE PAKISTAN NUCLEAR POWER PROGRAM. Khan, M. A.; Zaidi, S. M. N.; Bhutta, S. M. (Pakistan Atomic Energy Commission, Dacca). pp Paper No. CNA'73-401 of Proceedings of the Thirteenth Annual International Conference of the Canadian Nuclear Association. Toronto; Canadian Nuclear Association (1973).

From 13th annual international conference of the Canadian Nuclear Association; Toronto, Ontario (17 Jun 1973).

The role of nuclear power in filling the power requirements of Pakistan for the next two decades is weighed against other energy resources such as hydro and natural gas available in the country. The significance of the Karachi Nuclear Power Plant (KANUPP) in initiating the nuclear program is evaluated, and commissioning and operation experience are discussed in some detail. (CA)

23237 MOSHCHNYE ATOMNYE ELEKTROSTANTSII ZA RUBEZHOM (SSHA, BELIKOBRITANIYA, FRG). (Large Nuclear Power Plants Abroad (USA, Great Britain, German Federal Republic)). Petros'yants, A. M. Moscow; Izdatel'stvo Znanie (1974). 63p.

The status of nuclear energy in the USA, Great Britain, and the German Federal Republic is outlined. A description is given of some large nuclear power plants and nuclear research centers concerned with the development of nuclear energy. The most significant future trends in the development of nuclear power plants in these countries are also considered. (tr-auth)

23238 WHAT NUCLEAR POWER MEANS TO CANADIAN INDUSTRY. Weller, J. A. (Canadian Nuclear Association, Toronto). Nucl. Eng. Int.; 19: No. 217, 500-503(Jun 1974).

The activities of the Canadian nuclear industry in the fields of heavy water production, fuel fabrication, and production of reactor components are summarized. A folding chart shows the structure of the industry, listing national bodies, research and design centers, and industrial concerns. Their interests and inter-connections are shown. (UK)

23239 NUCLEAR POWER GENERATION IN JAPAN. J. Inst. Nucl. Eng.; 15: No. 3, 86-90(May 1974).

The main reasons why Japan is placing great emphasis on the development of nuclear power are stated. Nuclear power at present accounts for only a very small fraction of Japan's energy supply, but is expected to rise to about 10% by 1985. Five nuclear plants with total capacity of 1.82 million KW are at present in operation for commercial power generation, and 17 stations with an aggregate output of 13.65 million KW are under construction. Demand for electrical power is expected to increase at a yearly rate of about 10%. Of the reactors now in operation most are of the light water type; there is one gas cooled reactor, but high temperature gas cooled reactors may be installed, and an experimental fast breeder is under construction. Consideration is given in this paper to generating costs, safety, power plant sites, availability of fuel, and growth of the nuclear equipment industry in Japan. (UK)

23240 16th ANNUAL REPORT OF JAPAN ATOMIC ENERGY COMMISSION. Tokyo; Japan Atomic Energy Commission ([nd]). 214p.

The fiscal 1971 has been a characteristic year for the development and utilization of atomic energy in Japan. First, amidst the national concern on environmental issues, conservation of the environment and nuclear safety were especially important to atomic energy development. Second, the problems of uranium resources and enriched uranium were significant and international joint uranium enrichment projects are discussed. The following are described: nuclear power generation, nuclear fuels, enriched uranium, safety, environmental aspects, conservation, development of power reactors, nuclear ships, radiation applications, basic research and special integrated research on atomic energy, and nuclear industry. (JA)

23241 FUTURE TREND IN DISTRICT HEATING. The Economic Relevance of Regional Nuclear District Heating Schemes. Margen, P. H. (Aktiebolaget Atomenergi, Studsvik, Sweden). Energy World; No. 7, 11-14(Jul 1974).

In Sweden, where all cities of any size already have district heating schemes in the city centers, the future use of waste heat

from nuclear plants is now regarded as a development which can make district heating next to nuclear power the most important single development for fuel conservation, environment improvement, and reduced energy costs in the coming decades. The economics of the reduction in electricity output and gain in utilized heat energy due to combined heat/electric operation of a nuclear plant is considered. To be really economic, new nuclear heat/electric stations have to be large because of the relatively high minimum capital investment and also have to be located outside densely populated areas. The siting of such nuclear heat/electric stations in Sweden is considered. The basic economic case for using nuclear heat/electric stations for supplying the base load heat block is discussed. (UK)

23242 NUCLEAR HEAT. Grenon, M. Rev. Fr. Energ.; 25: No. 261, 388-393(Mar 1974). (In French).

For a long time, technicians and economists have studied the possibilities of using nuclear heat directly for either heating systems in the cities or for industrial applications. The most important programs in this field which have gone beyond the experimental stage are recalled. (FR)

23243 NUCLEAR ENERGY IN JAPAN. Casa, A. F.; Perilli, M. L.; Sansone, M. M. Com. Naz. Energ. Nucl., Notiz.; 20: No. 5, 57-71(May 1974). (In Italian).

A review of the present nuclear picture in Japan is presented with particular reference to the nuclear power program and fuel activities, including enrichment, to radiation problems, to nuclear waste disposal, etc. A brief description is also given of the major research agencies and centers. (auth)

23244 REPORT ON BUILDING PROJECTS AND PROJECTS IN EUROPE. P. 2. New Nuclear Power Stations in Europe. Atomwirtsch., Atomtech.; 19: No. 5, 239-257(May 1974). (In German). 25 figs.; 2 tabs.; 4 refs.

A survey is given of the nuclear power stations of the various European countries which were in operation, under construction or projected in 1973. (GE)

23245 CENTRAL POINTS OF INTEREST IN THE DEVELOPMENT OF THERMAL POWER PLANTS. Dibelius, G. (Technische Hochschule, Aachen); Schwarz, O. Vgb Kraftwerkstech.; 54: No. 3, 194-202(Mar 1974). (In German).

Following a brief discussion of the demand for and resources of primary energy, the power plant systems (fossil-fired and nuclear) presently installed or under construction in the FRG are reviewed. New technological developments required in the near future or in the long run to meet the projected energy demands are also discussed, considering e.g., fuel cycle problems, heat removal and site selection. (GE)

23246 POWER PLANT CAPITAL COSTS GOING OUT OF SIGHT. Olds, F. C. Power Eng.; 78: No. 8, 36-43(Aug 1974).

Data on nuclear power plant construction costs are presented, and the growing cost increases and time schedule slippages are discussed. Projections for future nuclear power plant costs and comparisons between projected nuclear and fossil power plant costs are made. (DG)

23247 NUCLEAR POWER IN CANADA: A DIFFERENT APPROACH. Boyd, F. C. (Dept. of Energy, Mines, and Resources, Ottawa). Energy Policy; 2: No. 2, 126-135(Jun 1974).

The Canadian nuclear program is briefly reviewed from its beginning in 1941 to the present. Special emphasis is placed on the PHWR type (CANDU) reactor and its advantages. (DG)

23248 PROSPECTS FOR INDUSTRY IN CANADA RELATED TO THE NUCLEAR POWER PROGRAMME. Foster, J. S. (Atomic Energy of Canada Ltd., Sheridan Park, Ont.). Can. Mech. Metalwork.; 85: No. 6, 74-75; 91(Jun 1974).

The Canadian content of materials and components for Canada's nuclear power program is briefly summarized. The present nuclear capacity of 2.5 GW will be increased by 3.5 GW under construction and 8 GW projected for 1980-1984. Total nuclear capacity may be 130 GW by the end of the century. This will entail at least a tenfold expansion of manufacture of materials and components by 1990. The reactor vessels have always been made in Canada as have end-fittings for pressure tubes, reactor-control devices, and refuelling machines. Although the country has a plant to manufacture zirconium alloys, it is not economical. At present the calandria tubes are made in Canada, and it is expected that domestic finishing of Zircaloy fuel sheathing and manufacture of zirconium-niobium pressure tubes will begin very soon. Heat exchangers have always been Canadian, but the tubing is imported. For the most part, component instruments and computers are imported. Fuel is made by Westinghouse Canada and Canadian General Electric from U_3O_8 produced by Eldorado Nuclear. Despite initial mistakes, the country is now self-supporting in heavy water, with present nominal capacity of 1200 Mg/year (actual 800 Mg/year) due to be increased to a nominal 3200 Mg/year by 1978. (CA)

23249 SOME OPTIMIZATION AND MANAGEMENT PROBLEMS OF THE NUCLEAR POWER SYSTEM IN ITS DEVELOPMENT. Novak, S. (Power Research Inst., Joslovske Bohunice, Czech.). Jad. Energ.; 20: No. 6, 182-185(Jun 1974). (In Czech).

For the optimization and management of the developing nuclear power system it is useful to form an automatization management information system (AMIS). Management, systems, and subsystems are classified in application and the conditions for gradual forming of AMIS are discussed. (auth)

Reactor Fuel Cycle Economics

Refer also to abstracts 20827, 21054, 21055, and 23240.

Reactor Licensing and Regulation

23250 (DOCKET-50281-213) SURRY POWER STATION, UNIT 2. First Year Operation Report, June 26, 1974. (Virginia Electric and Power Co., Richmond (USA)). 26 Jun 1974. 101p. Dep. NTIS $8.25.

An evaluation of plant performance in comparison with design predictions and specifications; a reassessment of the safety analysis in light of measured operating characteristics; an assessment of the performance of structures, systems, and components; and a progress and status report on items requiring additional information are presented for the first year of operation of the Surry-2 reactor. (FS)

23251 (DOCKET-50500-1) DAVIS-BESSE NUCLEAR POWER STATION, UNITS 2 AND 3. License Application. (Toledo Edison Co., Ohio (USA)). 7 Aug 1974. 362p. (DOCKET-50501-1). Dep. NTIS $21.25.

Application is made for construction and operating licenses for the Davis-Besse Nuclear Power Station, Units 2 and 3. Units 2 and 3 will be identical pressurized water reactor steam supply systems operating at a maximum core power level of 2772 MW(t) each. Units 2 and 3 will be located at the Unit 1 site on Lake Erie, approximately 21 miles east of Toledo. Annual reports containing financial and other data are included in support of the application. (JWR)

23252 (DOCKET-50514-1) PEBBLE SPRINGS NUCLEAR PLANT, UNITS 1 AND 2. License Application. (Portland General Electric Co., Oreg. (USA)). 2 Aug 1974. 39p. (DOCKET-50515-1). Dep. NTIS $5.00.

The Pebble Springs facility is located in Gilliam County in north-central Oregon about three miles southeast of the Columbia River. The plant includes two identical PWR type reactors. Each reactor has a core power rated at 3600 MW(t) with electrical output of 1367 MW(e). The facility includes a man-made cooling reservoir and two spray ponds. (FS)

23253 (DOCKET-STN-50483-9) CALLAWAY PLANT, UNITS 1 AND 2. License Application. (Union Electric Co., St. Louis, Mo. (USA)). 26 Jun 1974. 134p. (DOCKET-STN-50486-9). Dep. NTIS $9.75.

Two nuclear generating units utilizing Westinghouse pressurized water reactors are described. Each reactor will have an initial nuclear output of 3411 MW(t) and an additional non-nuclear output of 14 MW(t). Each unit will produce approximately 1150 MW(e) at full power. The site is located in Callaway County, Missouri about 10 miles southeast of Fulton and 5 miles north of the Missouri River. Unit 1 will be completed for commercial operation in October 1981 and Unit 2 in April 1983. (FS)

23254 (DOCKET-STN-50485-11) STERLING POWER PROJECT NUCLEAR UNIT 1. License Application. (Rochester Gas and Electric Corp., N. Y. (USA)). 30 Apr 1974. 59p. Dep. NTIS $6.00.

A reactor facility utilizing a PWR, which has an operational capacity of 1150 MW(e) or 3425 MW(t), is described. The earliest completion date is October 1982, and the latest is May 1983. The reactor site consisting of 2800 acres is located in the town of Sterling in Cayuga County, New York on Lake Ontario. (FS)

23255 (REG/G-1.70.6(7-74)) ADDITIONAL INFORMATION QUALITY ASSURANCE DURING DESIGN AND CONSTRUCTION. (USAEC Directorate of Regulatory Operations, Washington, D. C.). Jul 1974. 7p. DRS Free.

Quality assurance information to be included in the Preliminary Safety Analysis Report submitted by applicants for AEC review is described. (DG)

23256 QUALITY ASSURANCE REQUIREMENTS IN NUCLEAR SYSTEMS. Lingafelter, J. W. (Nuclear Services Corp., Campbell, CA). Trans. Amer. Nucl. Soc., Suppl.; 19: No. 2, 2-3 (1974).

From conference on nondestructive testing in the nuclear power industry; Columbus, OH (23 Sep 1974).

23257 PROPOSAL FOR IMPROVING CODES, STANDARDS, AND SPECIFICATIONS. Chockie, L. J. (General Electric Co., San Jose, CA). Trans. Amer. Nucl. Soc., Suppl.; 19: No. 2, 18 (1974).

From conference on nondestructive testing in the nuclear power industry; Columbus, OH (23 Sep 1974).

23258 FUTURE TRAINING AND CERTIFICATION NEEDS FOR NONDESTRUCTIVE TESTING PERSONNEL. Hovland, H. Trans. Amer. Nucl. Soc., Suppl.; 19: No. 2, 18-19(1974).

From conference on nondestructive testing in the nuclear power industry; Columbus, OH (23 Sep 1974).

23259 QUALIFICATIONS AND DUTIES FOR AUTHORIZED NUCLEAR INSPECTION. New York; American Society of Mechanical Engineers (1974). 4p. (ANSI-N-626-1974).

A description is given of the requirements for the Qualifications and Duties of the Authorized Inspection Agency, its Supervisors, and the Authorized Nuclear Inspector, as covered in the ASME Boiler and Pressure Vessel Code, Section III, Division I, Nuclear Power Plant Components. (auth)

23260 LICENSING AND REGULATIONS OF THE CANADIAN NUCLEAR PROGRAMME. Blackburn, R. W. (Atomic Energy Control Board, Ottawa). Nucl. Eng. Int.; 19: No. 217, 510-512 (Jun 1974).

The Atomic Energy Control Board is responsible for the regulatory and non-promotional aspects of the Canadian nuclear program. Main functions are to control nuclear facilities, equipment, materials, and information, to award grants, and to administer certain aspects of the Nuclear Liability Act. Control is exercised by the Atomic Energy Control Regulations and a comprehensive licensing system. These are briefly described. Licensing codes have been prepared for applying the basic provisions of the regulations to reactors and other facilities. Under the auspices of the Canadian Nuclear Association, efforts are also being made to prepare codes reflecting Canadian requirements, e.g., for the design, building operation, inspection, and repair of Candu reactors. Policies relating to siting approval and public involvement are outlined. (UK)

23261 EMERGING CODES AND STANDARDS FOR THE NUCLEAR INDUSTRY. Hake, G. (Atomic Energy of Canada Ltd., Chalk River, Ont.). pp Paper No. CNA'73-602 of Proceedings of the Thirteenth Annual International Conference of the Canadian Nuclear Association. Toronto; Canadian Nuclear Association (1973).

From 13th annual international conference of the Canadian Nuclear Association; Toronto, Ontario (17 Jun 1973).

The necessity for developing reliable nuclear codes and standards for licensing power reactors is discussed. Codes and standards presently being used or set in the U. S. are compared to Canadian needs, with regard to the Candu Reactor system. (CA)

23262 CITIZEN GROUPS AND THE NUCLEAR POWER CONTROVERSY: USES OF SCIENTIFIC AND TECHNOLOGICAL INFORMATION. Ebbin, S.; Kasper, R. MIT Press Environmental Studies Series. Cambridge, MA; Massachusetts Institute of Technology Press (1974). 315p. $6.95.

Citizen input into the nuclear power plant siting controversy is analyzed by considering the evolution of citizen concern and the motivation for citizen involvement and by reviewing USAEC procedures for licensing and rule making. Three specific cases, i.e., the construction permit hearings on nuclear power plants proposed at Midland, Michigan, the operating license proceedings for the Vermont Yankee Nuclear Power Plant at Vernon, Vermont, and the rule-making hearings on criteria for emergency core cooling systems, were studied in detail and the role of all parties involved in these hearings is analyzed. It was found that the AEC proceedings fail to provide a meaningful forum for public participation. Eleven specific recommendations are made for changing and improving the process of citizen participation. (LCL)

GENERAL

Civilian Defense

Refer also to abstract 21060.

Energy Utilization and Economics

Refer also to abstract 21049.

23263 (ORNL-EIS-74-52(Vol.2)(No.3)) NSF-RANN ENERGY ABSTRACTS. A Monthly Abstract Journal of Energy Research. Guthrie, M. P. (ed.). (Oak Ridge National Lab., Tenn. (USA)). Mar 1974. Contract W-7405-eng-26. 42p. Dep. NTIS $5.25.

The bibliography covers published research on energy sources, electric power (generation, supply and demand, transmission, environmental effects, and use), and energy (production, consumption, supply and demand, and policy). The research publications cited are technical journal articles, popular or semi-technical magazine articles, topical reports, symposium papers and proceedings, monographs, and books published within the past two years. A total of 97 abstracts are presented. (MCW)

23264 (SLA-74-5078) AXIAL TEMPERATURE DIFFERENTIAL ANALYSIS OF LINEAR FOCUSED COLLECTORS FOR SOLAR POWER. Lee, D. O.; Schimmel, W. P. Jr. (Sandia Labs., Albuquerque, N. Mex. (USA)). [nd]. 7p. (CONF-740805-3). Dep. NTIS $4.00.

From 9th Intersociety Energy Conversion Engineering Conference; San Francisco, California, USA (26 Aug 1974).

Collection of solar energy over a moderate temperature range has been analytically studied. Specifically, Therminol 66 was used as the collector fluid in this study. The effects upon performance of receiver absorptance and emittance, silvering of the collector envelope, and the diameter of the envelope are considered. Convective and radiative transport between the receiver and envelope and from the envelope to the environment are modeled; however, wind losses are not considered. Radiative exchange processes are modeled with an approximate two-wavelength-band model. Calculated results are presented for (1) varying values of specular solar input for Albuquerque, New Mexico, on a statistical June 21, (2) fluid flow rate, (3) initial fluid temperature for both silvered and unsilvered envelopes, and (4) both evacuated and unevacuated envelopes. The effect of varying envelope diameter is also considered. This study indicates that the best extraction of energy and the best temperature rise in the fluid occurs in the turbulent flow regime of the collector fluid. The maximum, however, for any given flow rate with a given inlet temperature occurs just after transition from laminar to turbulent flow. (auth)

Information Handling

Refer also to abstract 23322.

23265 (IS-3387) DESCRIPTION OF A BATCH OPERATED RETROSPECTIVE INFORMATION RETRIEVAL SYSTEM. Jordan, J. R.; Sun, R. P.; Maple, C. G. (Ames Lab., Iowa (USA)). Jul 1974. Contract W-7405-eng-82. 21p. Dep. NTIS $4.00.

The document is a manual to be used as a guide to maintaining and upgrading the retrospective information retrieval system. A description of the system, retrieval process, and data base construction process are presented. The method of taping the data of the SDI system for input to the retrieval system is outlined. (auth)

23266 (IS-3388) OPERATION AND MAINTENANCE OF THE RARE-EARTH INFORMATION CENTER'S INFORMATION RETRIEVAL SYSTEM (RICIRS). Jordan, J. R.; Sun, R. P.; Maple, C. G. (Ames Lab., Iowa (USA)). Jul 1974. Contract W-7405-eng-82. 17p. Dep. NTIS $4.00.

The RICIRS system is a keyword based retrieval system capable of retrieving bibliographic information from a direct-access device. The document describes the process of updating the data bases and constructing the retrieval request. (auth)

23267 (IS-3390) SDI OPERATING AND MAINTENANCE MANUAL. Sun, R. P.; Jordan, J. R.; Maple, C. G. (Ames Lab., Iowa (USA)). Jul 1974. Contract W-7405-eng-82. 87p. Dep. NTIS $5.45.

The Selective Dissemination of Information service provides notices of current literature to its users. The service is offered by the Computation Center of Iowa State University. The manual is a guide to operating and maintaining the SDI computer system. It describes system programs, operating procedure, and construction of a user's profile. System flow charts and program and file specifications are presented. The appendices contain source tape field identification numbers and job control and listing. (MCW)

Law

Refer also to abstracts 21094 and 21370.

23268 (WASH-1328) LEGISLATION TO AMEND THE PRICE-ANDERSON ACT. Draft Environmental Statement. (USAEC Directorate of Licensing, Washington, D. C.). May 1974. 124p. Dep. NTIS $9.25.

The proposed action is enactment of legislation to amend the Price-Anderson Act (section 170 of the Atomic Energy Act of 1954, as amended, 42 USC 2210). The requirement of the Act that certain licensees provide financial protection and be indemnified for public liability claims arising out of a nuclear incident would be extended for ten years, from August 1, 1977 to August 1, 1987. The legislation would provide a mechanism whereby increased financial protection made available by the nuclear insurance industry can by the mid-1980s phase out government indemnity now provided through appropriated funds. For those AEC licensees or contractors required to maintain financial protection equal to the maximum amount of liability insurance available from private sources the proposed legislation would provide for a limitation of liability equal to $560 million or the maximum amount of financial protection available, whichever is more. If there were no extension of the Price-Anderson system either through the Commission's proposed legislation or an alternative and the Act were allowed to expire on July 31, 1977, it is conceivable that some utilities might decide to build fossil fuel plants in lieu of nuclear facilities. The cost-benefit analysis examines the environmental impact of substituting fossil plants for nuclear plants in the following areas (a) dollar costs of generation of electricity, (b) water consumption, (c) air pollution, (d) land requirements, (e) radiological effects on man. From this analysis the following is concluded: (a) Capitalized value of the additional costs of generation which may result from substitution of coal for nuclear generating plants ranges from $1.35 billion to $24.6 billion in present value terms at the time of modification of the Price-Anderson Act depending on various scenarios, (b) water consumption and exposure to radiation are generally less for coal plants than for nuclear plants while potential degradation of air quality is greater for coal plants than nuclear plants, (c) coal plant sites may require more acreage than nuclear plant sites. Alternative systems were considered. (auth)

23269 AEC BEGINS FIRST ANTITRUST HEARING IN LICENSING CASE. Frisk, F. W. Jr. Pub. Power; 31: No. 6, 10-13 (1973).

In 1970, Congress passed an amendment to the Atomic Energy Act of 1954 which was intended to stop monopolization of nuclear power plants. The amendment requires AEC in every nuclear power plant licensing case to consider "whether the activities under the license would create or maintain a situation inconsistent with the antitrust laws." The Midland plant being built by Consumers Power Company in Michigan is the first for which evidentiary hearings have started. A review is presented of this and other nuclear generating facilities subject to AEC antitrust review. (SFL)

23270 RECENT AMENDMENTS AND INTERPRETATIONS OF THE AEC RULES OF PRACTICE: A SOLUTION TO DELAY. Dignan, T. G. Jr. At. Energy Law J.; 16: No. 1, (Spr 1974).

A review is made of recent changes and interpretations of the AEC Rules of Practice, with a view to determining whether the AEC's goal of expediting the licensing practice has been and will be furthered. Specific cases dealing with delays were cited. In the licensing cases decided in the 1969-1972 period, nothing resulted in more delay than repeated attack on certain regulations or retrying of various generic issues by intervenors in numerous and separate licensing proceedings. Until the promulgation of the 1972 amendments to the Rules of Practice, the rule governing attacks on regulations in individual licensing cases were those articulated by the Commission in 1969 in the Calvert Cliffs Memo acknowledging the basic principle that Commission regulations are not subject to amendment in individual licensing proceedings. (MCW)

23271 ATOMIC ENERGY COMMISSION'S ECCS RULE-MAKING. Bauser, M. A. At. Energy Law J.; 16: No. 1, 42-90(Spr 1974).

A synoptic view and critical analysis of the emergency core cooling system (ECCS) rule-making as conducted by the USAEC

are presented. The public hearings on the acceptability of interim criteria for ECCS was begun in January 1972 and completed on Dec. 28, 1973. The hearings are narrated with some extracts from the hearings given. Appendix A contains some general scientific facts on ECCS concepts. (MCW)

23272 REVISING AND AMENDING THE PRICE-ANDERSON INDEMNITY PROVISIONS OF THE ATOMIC ENERGY ACT OF 1954, AS AMENDED. Report by the Joint Committee on Atomic Energy Together With Separate View, Ninety-Third Congress, Second Session. Washington, DC; Joint Committee on Atomic Energy (1974). 37p. GPO.

A report is presented on the public hearings on the possible modifications or extension of the Price-Anderson Act that were held on January 31, March 27 and 28, 1974 and hearings on H. R. 14408, S. 3254, and S. 3452 that were held on May 9, 10, 14, 15, and 16, 1974. An informal planning committee consisting of personnel from the Joint Committee staff, the AEC, the legal profession, the commercial power and insurance industries, and public citizen groups were in attendance. The Act, designed to protect the public and the emerging nuclear industry by assuring the availability of funds for the payment of claims in the unlikely event of a catastrophic nuclear incident, is scheduled to expire on Aug. 1, 1977. A separate view is presented by Rep. Teno Roncalio and recommended opposition to the enactment of the renewal of the Price-Anderson Act at this time. (MCW)

23273 A BILL TO AMEND THE ATOMIC ENERGY ACT OF 1954, AS AMENDED, AND THE ATOMIC WEAPONS REWARDS ACT OF 1955, AND FOR OTHER PURPOSES, IN THE HOUSE OF REPRESENTATIVES, NINETY-THIRD CONGRESS, SECOND SESSION, MAY 20, 1974. Washington, DC; Joint Committee on Atomic Energy (1974). 6p. GPO.

The details are given of a bill to amend the Atomic Energy Act of 1954, and the Atomic Weapons Rewards Act of 1955, the latter to be known now as the Atomic Weapons and Special Nuclear Materials Rewards Act. The provisions of the new bill, H. R. 14901, are stated. (MCW)

23274 SERIOUS IMPLICATIONS OF WIDESPREAD NUCLEAR POWER DEVELOPMENT. Krieger, D. Sci. Forum; 7: No. 3, 9-12(Jun 1974).

The potential threat to global peace and security posed by widespread nuclear power development throughout the world is discussed from the point of view of (a) the dangers of nuclear proliferations; and (b) the deliberate destruction of nuclear plants during conventional warfare or by terrorist groups. The production of plutonium-239 by way of the fission process by states with a modest level of technological development could lead to a proliferation of nuclear weapons. The sabotage and destruction of nuclear plants, waste storage areas, and other facilities would release vast quantities of radioactive material into the environment. The problems to be faced by national and international security systems are outlined. (CA)

23275 REGULATION FOR THE APPLICATION OF THE X-RAY ORDINANCE. Communication by the BMA and the BMJFG of January 7, 1974-BMA III b 6-3882.4030-1004/74 and BMJFG 333-4268-28-114/73. Arbeitsschutz (Koeln); No. 2, 2-24(1974). (In German).

Text of a circular letter concerning the application of the X-ray Ordinance, sent to the highest authorities responsible for the application of the ordinance in the German Federal Republic is given. The letter refers to regulations concerning the training and examination of radiation protection and health physics experts, guidelines relating to examinations in accordance with paragraph 4 section 1 of the X-ray Ordinance, and the establishment of competences. (GE)

23276 ADVANCED NUCLEAR RESEARCH. Hearing Before the Subcommittee on Aeronautics and Space Technology of the Committee on Science and Astronautics, U. S. House of Representatives, Ninety-Third Congress, Second Session, February 7, 1974. Washington, DC; Committee on Science and Astronautics (1974). 78p. GPO.

The oversight review included discussions on: a better understanding of how the results of nearly $1.5 billion worth of nuclear power and propulsion research and development will be kept available for use in the future; determination of how NASA and the AEC will maintain a viable long-range capability in advanced nuclear power and propulsion research; and the determination of how the results of both past and future research can be incorporated in applications for solving problems related to energy and other terrestrial applications. Statements were from representatives from NASA, the AEC, and contracting firms. The U. S. nuclear rocket program beginning with Project ROVER in 1955 is reviewed. (MCW)

23277 ATOMIC ENERGY LEGISLATION THROUGH NINETY-THIRD CONGRESS, FIRST SESSION, JOINT COMMITTEE ON ATOMIC ENERGY, CONGRESS OF THE UNITED STATES, JULY 1974. Washington, DC; Joint Committee on Atomic Energy (1974). 421p. GPO $3.10.

Part I of this collection of statutes and material pertaining to atomic energy legislation is entitled, The Atomic Energy Act of 1954, as amended. Titles of Chapters and Sections are: declaration, findings, and purpose; definitions; organization; research; production of special nuclear material; special nuclear material; source material; byproduct material; military application of atomic energy; atomic energy licenses; international activities; control of information; patents and inventions; general authority; compensation for private property acquired; judicial review and administrative procedure; Joint Committee on Atomic Energy; enforcement; and Chapter 19 is on miscellaneous items. Part II is: AEC Authorization Acts (with amendments) and Public Laws from 1956 to 1974. The Euratom Cooperation Act of 1958 and Concurrent Resolution is published in Part III. Part IV is the International Atomic Energy Agency Participation Act of 1957. The Atomic Energy Community Act of 1955, as amended, is published in Part V, followed by Appendixes containing related legislation. (MCW)

23278 ATOMIC ENERGY AND RADIOACTIVE SUBSTANCES. The Radioactive Substances (Thorium-X) Exemption (Scotland) Amendment Order 1974. Statutory Instruments 1974, No. 488 (S.36). London; Her Majesty's Stationery Office (1974). 2p.

In the principle order for the words "Board of Management" there shall be substituted the words "Health Board." Unless the context otherwise requires, references in the principal order to any enactment shall be construed as references to that enactment as amended or re-enacted by any subsequent enactment. (text of amendment) (UK)

23279 ATOMIC ENERGY AND RADIOACTIVE SUBSTANCES. The Radioactive Substances (Thorium-X) Exemption (Amendment) Order 1974. Statutory Instruments 1974, No. 500. London; Her Majesty's Stationery Office (1974). 2p.

In article 2(1) for the definition of "National Health Service hospital" there shall be substituted the following definition: "National Health Service hospital means a hospital with respect to the management and control whereof any functions are exercised by an Area Health Authority or a Board of Governors specified in an order made under section 15 of the National Health Service Reorganization Act 1973." In article 5(2) and at the end thereof there shall be added the words "as amended by the National Health Service Re-organization Act 1973." (text of amendment) (UK)

Management

Refer also to abstract 21061.

23280 (AECL-4828) CHEMISTRY AND MATERIALS DIVISION PROGRESS REPORT, JANUARY 1 TO MARCH 31, 1974. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). May 1974. 106p. (PR-CMA-28). Dep. NTIS (U. S. Sales Only) $8.50. AECL $2.00.

Research in progress in the Solid State, General Chemistry, Physical Chemistry and Materials Sciences Branches, McMaster University, University of B. C., University of Ottawa, Queen's University, and University of Guelph is highlighted. The staff and publications are included. (LK)

23281 (AECL-4830) ANNUAL REPORT, 1973-1974. (Atomic Energy of Canada Ltd., Chalk River, Ontario). 17 May 1974. 50p. Dep. NTIS (US Sales Only) $5.50.

The annual report of the Atomic Energy of Canada Limited includes summaries of nuclear power development; radiation and radioisotopes; research; operation and administration; AECL and industry; AECL and the universities; international collaboration; Nelson River transmission facilities; and the auditor general's report. (MCW)

23282 (IJS-P-284) ANNUAL REPORT FOR 1973. Smalc, A. (Institut Jozef Stefan, Ljubljana (Yugoslavia)). Mar 1974. 195p. (In Slovene). Dep. NTIS (US Sales Only) $12.75.

The work done in physics, chemistry, biochemistry, electronics, and reactors is briefly indicated. A list of published and unpublished work is appended. The organization of the Institute is outlined. (JSR)

23283 (IKE-K-41) ANNUAL REPORT 1973. (Stuttgart Univ. (TH) (F. R. Germany). Inst. fuer Kernenergetik). 1973. 25p. (In German). INIS.

The research programs of the Institut fuer Kernenergetik of the University of Stuttgart are outlined. Programs include reactor theory, medical radiation techniques, reactor safety, date processing, direct energy conversion, heat pipes, high temperature technology, recording of measured data, and electronic control equipment. A list of publications, doctoral theses, diploma theses and lectures written or held in 1973 is added. (auth)

23284 (INIS-MF-1168-2, pp vp, 16p) NUCLEAR ENGINEERING RESEARCH. Tunkelo, E. (Univ. of Helsinki). 1973.

From Finnish summer school in nuclear physics; Liperi, Finland (11 June 1973).

The staffs and the research projects in nuclear science and technology in the Department of Technical Physics at the Helsinki University of Technology and in the Reactor Laboratory at the Technical Research Center of Finland are described. (HDR)

23285 (UCID-16531) E-DIVISION PROGRESS REPORT FY 74. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jun 1974. Contract W-7405-eng-48. 11p. Dep. NTIS $4.00.

From BD; IK (NX).

Some of the activities of E (Experimental Physics) Division during 1973/74 are described. The report is not complete, as some of the research in pure nuclear physics or in support of other programs is not included. Activities are centered around four accelerators: a 100-MeV electron linac, a 400-keV dc high-current accelerator, a 6-MV tandem, and a 76-cm cyclotron. The areas of work described are fission, neutron transport and ENDF, nuclear physics (including charged-particle cross sections, photonuclear reactions, nuclear energy levels, and gamma-ray spectra), the intense source of 14-MeV neutrons, fusion reactors, atomic physics, and biomedical applications. The discussions are of a general nature, without data.(RWR)

23286 (UCID-16560) PROFESSIONAL PERSONNEL POLICIES AND PRACTICES OF R AND D ORGANIZATIONS. Van Atta, C. M.; Decker, W. D.; Wilson, T. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 6 Dec 1971. 81p. Dep. NTIS $7.00.

A study was made of policies and practices affecting professional personnel for maintaining the vitality and creativity of a research staff under conditions of essentially static employment. A summary of the LLL employment record was reviewed. Other research establishments were visited. The findings are discussed in topics on methods of acquiring a vital staff, techniques for maintaining vitality in the existing staff, and employee evaluation practices. (MCW)

23287 AEC AUTHORIZING LEGISLATION FISCAL YEAR 1975. Part I. Hearings Before the Joint Committee on Atomic Energy, Congress of the United States, Ninety-Third Congress, Second Session on General Statement and Appendixes, February 19, 1974. Washington, DC; Joint Committee on Atomic Energy (1974). 808p. GPO $5.35.

The Joint Congressional Committee on Atomic Energy met to hear the proposed AEC authorizing legislation for fiscal year 1975. AEC Commissioners and AEC senior staff members were scheduled to testify at the hearing and cover a broad overview of the AEC's plan, programs, and budget for the upcoming year. The request was approximately $3,600 million. Significant increases in the proposed budget include, $56.3 million for the LMFBR base program; $39.1 million for fusion research; $13.3 million for gas-cooled reactors; and a request for additional authorization of $332.5 million for the FFTF construction project. There were no funds for the second LMFBR demonstration plant, for coal liquefaction, for solar energy, and the OMB reduced AEC's request for the Plowshare program by $15.1 million. (MCW)

23288 AEC AUTHORIZING LEGISLATION FISCAL YEAR 1975. Part 2. Hearings Before the Joint Committee on Atomic Energy, Congress of the United States, Ninety-Third Congress, Second Session on Reactor Research and Development; Reactor Safety Research; and Applied Energy Technology, February 26 and 27, 1974. Washington, DC; Joint Committee on Atomic Energy (1974). 544p. GPO $3.80.

The hearings were begun with the opening statement by Chairman Price and with indications that the operating costs for the program had increased 32% over the current year's estimated costs. Increases in operating costs of $56.3 million for the LMFBR base program and $13.3 million for the gas-cooled reactors programs are given. An authorization of $332.5 million is being requested for the FFTF construction project. Some statements concerning these expenditures were expanded upon by Atomic Energy Commissioners, research and finance personnel, and safety directors. (MCW)

23289 LONG-TERM URANIUM DEMAND WILL BE MET. Fast Breeder Expected to Allow Better Utilization. Hossner, R. Handelsblatt; 29: No. 65, 5(Apr 1974). (In German).

1 fig.

A brief discussion is given of the present situation on the uranium market and further ways of ensuring the uranium supply in the future. The separative work required in the future is also dealt with. (GE)

Mathematics and Computers

Refer also to abstracts 21442, 21481, 21484, and 21487.

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23299 (IFVE-SVM-72-65) TRANSLATION FROM FORTRAN BY THE COMPUTERS WITH A SMALL OPERATIVE STORAGE. Issue 6. Translator Text. Section 2. Lupashina, I. S.; Luzina, A. S.; Makarov, V. A.; Popova, I. V.; Sokolov, S. N.; Kharybina, L. D. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1972. 30p. (In Russian). INIS.

This issue is the sixth in a series of works systematizing the reported translation from the FORTRAN language. Subprograms of the second section, responsible for selection from the text and the decoding of the basic elements of the FORTRAN language, are included. (tr-auth)

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The study of the separation of ions and/or concentration of ions by the use of ion exchange membranes was continued, with major effort being devoted to the investigation of the use of complexing agents in conjunction with ion exchange membranes to separate ions. Systems studied were dilute aqueous solutions containing Cu(II), Fe(II), Zn(II), and Fe(III). Data collected when using disodium ethylenediamine tetraacetic acid as a stripping and complexing agent indicate that separation of ions by the use of ion exchange membranes may or may not be caused by Donnan dialysis depending on flow rates. The amount of chelating agent used in the strip stream as well as its flow rate will determine separation of various ions of the same charge. The ratio of the raffinate flow rate to the extract flow rate at constant chelating agent concentration will determine the amount of separation of like-charged ions and other ions as well. With excess amount of chelating agent in the strip stream (that above the amount required to chelate all the cations in the feed stream), straight diffusion became the controlling factor rather than Donnan dialysis. It was found that ionic neutrality must be maintained in the separate portions of the system. Under various flow rates and concentrations of the chelating agents in the strip stream separation of ions in a system may be caused by a combination of driving forces including ionic diffusion, Donnan potential, stability constants of the chelate formed and ionic concentration differences. Results indicate that design of systems to separate various ions of the same charge or of different charge can be accomplished by the relation of flow rates of the raffinate and extract streams and the chelating agent concentration in the strip stream. Data collected closely support theoretical considerations when a chelating agent is used in the strip stream. Recovery of the cation from a chelated complex requires the formation of a cation compound with a high solubility product constant. Disodium ethylenediamine tetraacetic acid appears to be one of the best agents for use as a chelating compound for most ions as a separating agent. Thick channel systems with feed recycle are being investigated as a possible solution to produce systems of high volume flow with satisfactory separation. (auth)

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A technique is demonstrated for determining the Grüneisen parameter, stress wave attenuation, and dynamic tensile strength

of geological materials. The technique is applied to two novaculites and one granite. Grüneisen parameter and attenuation data are explained by the degree of porosity and homogeneity of the materials involved. Dynamic tensile strengths (1-4 kbar) are higher than previously observed, probably due to the very short time under tension. This work is in support of studies on the use of pulsed electron beams for fracturing rocks in drilling, tunnelling, excavation, and mining operations. (TFD)

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From 1st Latin symposium on magnetic resonance; Lima, Peru (16 Jul 1973).

23486 (UCID-15462) HEAT-PIPE OPTIMIZATION CODE, LAM2. Watts, J. L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 2 Apr 1969. 15p. Dep. NTIS $4.00.

In the evaluation of heat-pipe performance, it is necessary to know the maximum axial heat flux obtainable with respect to the optimum capillary pore size. The LAM2 code written to calculate this optimum pore size, and the corresponding maximum axial heat flux are described. (auth)

23487 (UCID-16526) SOME STUDIES OF DEEPLY BURIED HIGH EXPLOSIVE ROCK FRACTURING. Butkovich, T. R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 20 Jun 1974. Contract W-7405-eng-48. 21p. Dep. NTIS $4.25.

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23489 (UCID-16559) EFFECT OF STRATOSPHERIC AEROSOL ON LONGWAVE RADIATIVE FLUXES: VARIATION WITH LATITUDE AND SEASON. Luther, F. M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 19 Jul 1974. Contract W-7405-eng-48. 8p. Dep. NTIS $4.00.

23490 (UCLA-ENG-7416) EXPERIMENTAL STUDY OF TRANSLATIONAL RELAXATION IN ARGON AND HELIUM FREE JETS FOR OBTAINING VISCOSITY CROSS SECTION. Othmer, P. W. (California Univ., Los Angeles (USA). School of Engineering and Applied Science). Feb 1974. 158p. Dep. NTIS $11.00.

A free jet was formed experimentally and the nonequilibrium process occurring in the expanding gas of the free jet was modelled using the Boltzmann equation cast into a relaxation form. This nonequilibrium flow gives rise to two partial kinetic temperatures, namely, $T_\parallel$ and $T_\perp$ which describe the flow field. The model shows that $T_\parallel$ relaxes to an asymptotic value whereas $T_\perp$ follows the isentropic result to lower temperatures and switches over to the $(x/D)^{-1}$ dependence instead of the anticipated $(x/D)^{-\frac{4}{3}}$ dependence. Both argon and helium gases were studied. A molecular beam system was used to probe the free jet. The time-of-flight distributions were analyzed with the aid of several computer programs. The reduced data consisted of the values of parallel temperature, perpendicular temperature, Mach numbers, average velocities for a wide range in stagnation Knudsen number and axial positions along the jet center line. The resulting data were then used to predict an effective hard sphere diameter (σ) for both argon and helium gas at low temperatures. For argon the range of σ was from 3.5×10^{-8} to 6×10^{-8} cm for the 8 to 28°K temperature range. For helium the range of σ was 1.5×10^{-8} to 2.8×10^{-8} cm for the 20 to 72°K temperature range. (auth)

23491 (UCRL-Trans-10744) DISTRIBUTION OF ATMOSPHERIC CONTAMINANTS IN URBAN AREAS. Berlyand, M. E. Translated by H. C. Rodean and A. Kusubov from Meteorol. Gidrol.; No. 3, 45-47(1970). 20p. Dep. NTIS $4.00.

23492 (UR-3490-444) INTERNATIONAL PROGRAM FOR MICROWAVE EXPOSURE PROTECTION. Michaelson, S. M.; Suess, M. J. (Rochester Univ., N. Y. (USA); World Health Organization, Copenhagen (Denmark). Regional Office for Europe). 1973. 6p. (CONF-740610-2). Dep. NTIS $4.00.

From G-MTT international microwave symposium; Atlanta, Georgia, USA (12 Jun 1974).

23493 (UR-3490-478) DETERMINATION OF AEROSOL MASS DISTRIBUTION IN AN AEROSOL CENTRIFUGE BY MEANS OF QUARTZ OSCILLATORS. Moenig, F. J.; Schwarzer, N.; Stoeber, W. (Rochester Univ., N. Y. (USA). Dept. of Radiation Biology and Biophysics; Fraunhofer-Gesellschaft zur Foerderung der Angewandten Forschung e.V., Grafschaft/Hochsauerland (F.R. Germany). Inst. fuer Aerobiologie). [nd]. 8p. (In German). (CONF-731080-1). Dep. NTIS $4.00.

From 1st meeting of Gesellsch. f. Aerosolforsch; Bad Soden, F.R. Germany (20 Oct 1973).

23494 (USC-113P-69) REFLECTION FUNCTION FROM A DOUBLE LAYER: A NEW APPROACH. Technical Report No. RB73-42. Bellman, R.; Vasudevan, R. (University of Southern California, Los Angeles (USA)). Sep 1973. Contract AT(04-3)-113. 24p. Dep. NTIS $4.50.

To improve the accuracy of calculations for the reflection and transmission functions, doubling techniques are in use. The central theme of this method is to derive the total reflection function when two portions of a medium are adjoined together. The synthesis is done by the use of star produce techniques which require a knowledge of the S and T functions of both parts of the medium. Infinite series expansion is necessary to compute the total reflection. The method developed in this article splits the total reflected beam into two parts, one relating to that flux which suffers no scattering at all in the first portion of the medium and the second portion that undergoes at least scattering in the first portion. The first part can be evaluated simply by knowing the reflection function of the second portion of the medium. The other part of the total reflection for variations of the thickness of the first portion of the medium is found to obey a simple Riccati type integro-differential equation with zero initial conditions. Knowledge of the T functions is not necessary and integration has to be performed over the interval corresponding to thickness of the first portion of the medium. Order-of-scattering analysis is also carried out. (auth)

23495 (Y-EC-195(Rev. 1)) DESIGN ASPECTS OF A MULTI-WALL 1750°C FURNACE FOR 20,000 PSI ARGON OPERATION. Curtis, C. H.; Pohto, H. A. (Oak Ridge Y-12 Plant, Tenn. (USA)). [nd]. Contract W-7405-eng-26. 19p. (CONF-740606-17). Dep. NTIS $4.00.

From pressure vessels and piping-materials-nuclear conference; Miami Beach, Florida, USA (24 Jun 1974).

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